School of Psychology and Speech Pathology
Curtin University

Developing and testing a theory based behavioural intervention in overweight and obese adults: The Healthy Eating and Active LifesTyle Health Intervention

Anne Hattar

This thesis is presented for the Degree of
Doctor of Philosophy (Clinical Psychology)
of
Curtin University

May 2016

DECLARATION

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree of diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number: HR137/2013

Signature: _____

Date: 11 March 2016

ABSTRACT

Background and Study Aims: Obesity and overweight are major health problems worldwide. Overweight and obese individuals require significant weight-loss to reduce health associated risks such as cardiovascular disease, diabetes, and other chronic conditions. Previous interventions aiming to change health behaviour lack adequate descriptions of the adopted theory-based techniques, and precise description of the intervention conditions. The purpose of the current research was to develop and evaluate a weight-loss program titled Healthy Eating and Active LifesTyle Health Intervention (HEALTHI), and to test the predictions of the Health Action Process Approach model in the context of physical activity and dietary intake health behaviour. The current study examined the use of the HEALTHI, a 12-week randomised-controlled weight-loss program that adopted two theory-based intervention techniques, mental imagery and implementation intentions, shown to be effective in promoting health-behaviour change. The effectiveness of goal-reminder text messages to augment intervention effects was also tested. The trial determined the effects of the brief, low cost, theory-based weight-loss intervention to improve dietary intake and physical activity behaviour in order to facilitate weight-loss in overweight and obese individuals. The trial also examined the predictive ability of the theory-based variables on the behaviour change related outcomes.

Methods/Design: The current research developed the HEALTHI program based on a theoretical framework. The HEALTHI program was piloted through the use of focus group sessions and a thematic analysis was conducted that led to program amendments prior to finalising the program. The HEALTHI program was

implemented in an overweight or obese community sample (n = 74) with participants randomly allocated to one of three conditions: (1) a psycho-education plus an implementation intentions and mental imagery condition; (2) a psycho-education plus an implementation intentions and mental imagery condition with text messages; or (3) a psycho-education weight-loss condition. The intervention was delivered via video presentation using an online internet-based system, an approach adopted to increase the intervention's applicability in multiple contexts and keep costs low. It was hypothesised that the intervention conditions would predict changes indicating improvement in the primary and secondary outcome variables measured at 6 and 12 weeks post-intervention relative to the psycho-education weight-loss condition. The primary outcome variable was body weight, and secondary outcome variables were biomedical (body mass, body fat percentage, muscle mass, waist-hip circumference ratio, systolic and diastolic blood pressure, low-density lipoprotein, high-density lipoprotein, total cholesterol, triglyceride, blood glucose and insulin levels), psychological (quality of life, motivation, risk perception, outcome expectancy, intention, action self-efficacy, maintenance self-efficacy, goal setting and action planning), and behavioural (self-reported dietary intake and physical activity involvement) measures. The intervention condition augmented with text messages was also hypothesised to predict differences in the primary and secondary outcome variables with improvement at the follow-up periods relative to the psycho-education plus implementation intentions and mental imagery condition. In addition, the efficacy of the HAPA to explain changes in health behaviour and biomedical and psychological outcomes during the course of the intervention was also tested.

Results: The HEALTHI program was found to lead to improvements on the majority of the biomedical, psychological, and behavioural outcome variables over

time across all intervention conditions. Participants within the three conditions did not differ significantly with regards to the changes on the outcome variables. Findings suggest that the content of the psycho-education weight-loss condition alone may have been sufficient to change behaviour and that the additional intervention components (implementation intentions or action planning, mental imagery, and text messages) administered in the other conditions did not lead to greater changes in study outcomes relative to the psycho-education weight-loss condition. However, it is important to note that the absence of a non-intervention control condition within the study design did not allow an evaluation of the effectiveness of the psycho-educational components provided to all participants, including those allocated to the psycho-education weight-loss condition, in changing behaviour and other outcomes. Results also provided support for the key hypotheses of the HAPA in predicting change in the outcome variables and proposed mediation effects in the context of physical activity and dietary intake.

Conclusion: The planned trial examined the HEALTHI program: a theory-based, low cost intervention to reduce weight and salient psychological, biomedical, and behavioural outcomes in overweight and obese adults. Findings revealed that all of the intervention conditions led to changes in study outcomes over time but there were no differences in the study outcome variables across conditions relative to the psycho-education weight-loss condition. These findings suggest that the content of the psycho-education weight-loss condition may have been sufficient to evoke changes in study outcomes, however this cannot be confirmed as the study did not include a non-intervention control condition. To speculate, the changes may have been due to the sufficiency of the strategies included in the psycho-education weight-loss condition (e.g., weight-loss information, self-monitoring of dietary intake and

physical activity behaviour, and goal setting) in affecting behaviour change. The trial also found that changes in physical activity planning and behaviour were separate predictors of changes in the outcome variables, and that changes in dietary intake planning was a direct predictor of changes in the outcomes. The study was designed to maximise applicability of the intervention to real world settings so that it could be integrated into existing weight management practices. The HEALTHI program has the benefit of being accessible online and the psycho-educational content which was common to all groups could be effective in leading to weight-loss changes.

Trial Registration: ACTRN12613001274763.

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to my husband Marc. Your love, support, prayers, and encouragement helped me persist through challenging times. I am also grateful for your amazing assistance with proofreading. Also, a special thank you to my parents for their love and support, and to my sister Safa who was present in some of the intervention videos. I would also like to express my appreciation for Arun Raj for filming and editing the intervention video and the time and effort contributed towards this essential component of the study.

I further acknowledge John Curtin Distinguished Professor Martin Hagger and Associate Professor Sebely Pal for their guidance and advice. I am also thankful for the research analyses assistance provided to me by Dr Robert Kane. Thank you to Duke University for granting permission to use the Impact of Weight on Quality of Life scale (IWQOL-Lite) for this research project. Also, a special thank you to the individuals who participated in the research focus group and the clinical trial which made the research all possible. Your time and contribution are greatly appreciated.

DEDICATION

This thesis is dedicated to the memory of my grandfather who encouraged me to fulfil my dreams and complete my Doctor of Philosophy degree. Thank you for your encouragement and believing in me.

LIST OF PUBLICATIONS INCLUDED AS PART OF THESIS

Hattar, A., Hagger, M. S., and Pal, S. (2015). Weight-loss intervention using implementation intentions and mental imagery: A randomised control trial study protocol. *BMC Public Health, 15, 196.* doi:1186/s12889-015-1578-8

Hattar, A., Hagger, M. S., and Pal, S. (2016). Predicting physical activity-related outcomes in overweight and obese adults: A Health Action Process Approach. *Applied Psychology: Health and Well-being, 8*(1), 127-151. doi:10.1111/aphw.12065

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STATEMENT OF AUTHOR CONTRIBUTION

The nature and extent of the intellectual input by the candidate and co-authors has been validated by all authors, and can be found in Appendix A.

_____	_____	_____
Anne Hattar	Martin Hagger	Sebely Pal
(Candidate)	(Supervisor)	(Supervisor)

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CHAPTER ONE: Review of the Literature on Weight-loss, Health Behaviour Change and Theories of Health Behaviour

The problem of overweight and obesity

The high prevalence of overweight and obesity is a major health problem confronting Australia (National Preventative Health Taskforce, 2009). The Australian Bureau of Statistics (2012) reported that in 2011 to 2012, 63.4% of Australians aged 18 years and over, were overweight or obese, with 35.0% overweight (Body Mass Index or BMI, between 25.0 and 30.0kg/m2) and 28.03% obese (BMI > 30.0kg/m2). Obesity increases risk to a number of physiological health problems including; diabetes, ischemic heart disease, musculoskeletal disorders, and some cancers (World Health Organization, 2012). Psychological factors related to obesity also include increased risk of depression (Dixon, Dixon, & O'Brien, 2003; Hill, 2010), body image distress, low self-esteem, impaired quality of life, and binge-eating disorder (Hill, 2010).

Weight-loss has been shown to reduce the metabolic risk factors associated with obesity. For example, research has shown that modest weight losses of 5-10% of initial weight produces clinical improvements in cardiovascular disease risk factors in overweight and obese patients with type 2 diabetes (Wing et al., 2011). Blackwell (2002) reports that weight-loss assists overweight and obese individuals in decreasing obesity-related risk factors by ameliorating elevated blood pressure, total and low-density lipoprotein cholesterol levels, triglyceride levels, and increasing high-density lipoprotein cholesterol levels. Regular participation in physical activity can assist with weight-loss, and the reduction of psychological outcomes such as

assisting with the management of depression, anxiety and stress symptoms (Mello et al., 2013; Nieman, 2002).

Weight-loss

Overweight and obesity are conditions that arise due to an imbalance between the amount of energy consumed and energy expended (WHO, 2012). Wing and Hill (2001) report weight-loss is achieved through a 'negative' energy balance (i.e. greater energy expended though activity versus energy consumed from food), by decreased intake or increased expenditure. Research supports that if an individual changes diet and physical activity behaviours to achieve a negative energy balance, then successful weight-loss can be achieved (Blackwell, 2002; National Preventative Health Taskforce, 2009; The Diabetes Prevention Program Research Group, 2012a). Research recommends that an evidence-based weight-loss strategy should include a combination of a reduced calorie intake diet and increased physical activity (Blackwell, 2002; Foreman, 2009). Combining a calorie-reduced diet and regular physical activity has been shown to be effective in achieving weight-loss and preventing obesity-related risk factors (Blackwell, 2002; Donnelly et al., 2009; Mitsui, Shimaoka, Tsuzuku, Kajioka, & Sakakibara, 2008; Rodriguez, 2011; Shaw, Gennat, O'Rourke, & Mar, 2006). Research has found that with sustained behaviour change, the weight loss can be maintained in the long-term (Thomas, Bond, Phelan, Hill, & Wing, 2014). Weight maintenance behavioural strategies include, but are not limited to, adherence to a low-fat diet, exercise regimen including weight training, and regular self-weighing (Ballor, Katch, Becque, & Marks, 1988; Butryn, Phelan, Hill, & Wing, 2007; McGuire, Wing, Klem, Seagle, & Hill, 1998).

Dietary intake and weight-loss. Research suggests that a reduced calorie diet is an important component in weight-loss and there is good evidence that restricting caloric intake can promote weight-loss (Blackwell, 2002). Each individual has a minimum energy amount for body function, or the calories needed to maintain one's weight, which is referred to as basal metabolic rate (BMR; Boston, 2013). Reducing 500 calories per day can assist with a weight-loss of approximately 0.5 kilograms per week (Fernau, 2010). Fernau (2010) suggests that one strategy that individuals may use to try to manage the consumption of energy from food, is to count calories. When individuals consume more calories than they expend, the body converts the excess of calories into fat; if an individual expends more calories than they consume, then this assists in weight-loss (Fernau, 2010). Research has indicated that eating a low-calorie, low-fat diet is one of the six key strategies for long term success at initiation and maintenance of weight-loss (Wing & Phelan, 2005). Strategies to assist with calorie counting are; to spread calories throughout the day, read labels including the serving size and calories per serve, use a calorie counter such as a book or website, and monitor daily food and drink intake such as through the use of a food diary (*see* Fernau, 2010, for more information). The other strategies required for long term weight-loss identified by Wing and Phelan (2005) include involvement in physical activity, breakfast consumption, regular self-monitoring of weight, consistent eating pattern, and getting back on track when needed to prevent weight regain.

Water consumption is also important to maintain a healthy diet. Stookey, Constant, Popkin, and Gardner (2008) reported that the long term effects of water consumption on assisting body weight changes and composition are not known; however the information available from short-term experiments does suggest that

water consumption may assist with weight-loss through reducing total energy intake and/or altering metabolism. The Australian Dietary Guidelines (2013 p. 61) recommend that each day an individual is to "drink plenty of water." The guidelines suggest that the average intake of daily fluid consumption is 2.6 litres for adult males, and 2.1 litres for adult females. The Dieticians Association of Australia (2014) suggest that adults should aim for approximately 1.5 to 2 litres per day of water. It is recommended that fluid intake is mainly from plain water to preclude any unwanted stimulant effects (such as those found within tea and coffee fluids that contain water) and as water has no nutritive content in terms of caloric intake (Australian Dietary Guidelines, 2013).

Physical activity and weight-loss. Research suggests that physical activity can prevent obesity and assist with weight-loss, especially in combination with a diet intervention (Donnelly et al., 2009; Mitsui et al., 2008; Shaw et al., 2006). The Australian National Physical Activity Guidelines (2014) for adults defines physical activity as any activity that involves moving one's body, and leads to increased breathing and a faster heartbeat. Mitsui and colleagues (2008) found that physical activity (40 minutes of mainly walking) combined with a diet, assists in the improvement or prevention of metabolic syndrome evident in leading to reduced body mass index, waist circumference, and blood pressure by week 12 of the intervention. Donnelly and colleagues (2003) suggest that physical activity between 225 and 420 min per week can assist with weight-loss of 5 to 7.5 kilograms within 16 months. Physical activity guidelines in America and Australia recommend that adults engage in a minimum of 30 minutes of moderate activity on most or all days of the week to receive health benefits (Norton, Norton, & Sadgrove, 2010). The most recent Australian National Physical Activity Guidelines for Adults (2014) recommends that

each week, adults aged between 18 to 64 years accumulate 150 to 300 minutes of moderate intensity level physical activity, or 75 to 150 minutes of vigorous intensity level physical activity, or a comparable variety of both moderate and vigorous activities. In addition, the guidelines recommend that adults are active on most days, however preferably all days of the week.

Research indicates that increased physical activity can assist in improving risk factors associated with cardiovascular disease even in the absence of weight-loss (Shaw et al., 2006). The reduction of risk factors associated with cardiovascular disease include; reduced diastolic and systolic blood pressure, cholesterol, triglycerides, and fasting serum glucose (Shaw et al., 2006). Physical activity has also been found to be related to increased levels of high-density lipoproteins (Shaw et al., 2006). The current research measures these risk factors at post-intervention follow-up to examine the reduction in risk as a result of engagement in physical activity.

Changing Health Behaviours: Use of theories to guide intervention

Changes in diet and physical activity behaviour can assist with weight-loss and the reduction of obesity and related risk factors associated with chronic disease. To assist health professionals in supporting clients to lose weight, it is important to understand the underlying factors that are essential to change health behaviours for interventions to be successful. Interventions aiming to change health-related behaviour sometimes lack adequate descriptions of the techniques adopted, the definition of the health behaviour itself, the delivery modes of the intervention, and the precise description of the intervention conditions (Michie & Johnston, 2012; Stavri & Michie, 2012). The lack of this information does not allow one to identify

the ‘active ingredients’ of the intervention that facilitates behaviour change (Michie & Johnston, 2012). For this reason, there is a need to define the health behaviours, intervention delivery modes, intervention condition, and health behaviour techniques. In addition, basing the interventions on theory is useful because the cumulative knowledge of a theory explains the constructs, relationships, mediating factors, and change process. Theory provides a useful framework for hypothesis testing and confirming or falsifying research questions relating to the effectiveness of the intervention. The effectiveness of an intervention can be improved when theory guides the intervention design (Michie & Johnston, 2012; Taylor, Conner, & Lawton, 2011).

Interventionists in health contexts have adopted psychological theories and techniques to develop more effective interventions to change health behaviour and promote increased behavioural adherence. A number of theories and models have been adopted to understand health behaviour (Ajzen & Fishbein, 1980; Bandura, 2004; Conner & Norman, 2005; Kuhl, 1984; Schwarzer & Luszczynska, 2008). In the next section, some of these perspectives will be introduced and a description of how they link up with the understanding of changing health behaviour and promoting adaptive health outcomes with a focus on dietary intake and physical activity behaviour. The theories highlight various concepts that assist in understanding the promotion of behaviour change relevant to the foundation of the current intervention.

Interventions effective in guiding health behaviour change have adopted social cognitive models (Conner & Norman, 2005). Social cognitive models identify the key cognitive variables related to behaviour and the key processes by which they influence behaviour. The models have been applied to predicting and understanding health behaviours. A number of theories that have frequently been applied to

understanding health behaviour include the social cognitive theory, theories of reasoned action and planned behaviour, and action control theory. These theories informed the Health Action Process Approach (HAPA) model (Schwarzer & Luszczynska, 2008). The next section outlines the fundamental hypotheses of the key social-cognitive models relevant to the HAPA, with a view to identify key factors and processes associated with health behaviour, followed by a discussion of how the concepts have informed the development of the HAPA.

Social Cognitive Theory. Social cognitive theory specifies the determinants of behaviour, and the mechanisms through which they exert their effects (Bandura, 2004). According to the model, the determinants of health behaviour include; knowledge of health risks and benefits of different health practices, perceived self-efficacy that an individual can achieve control over health behaviours, outcome expectations of the costs and benefits associated with different health behaviours, health goals set by individuals including the plans and strategies for achieving them, and the perceived facilitators along with social and structural impediments to the health behaviour changes the individuals wish to make.

Self-efficacy is a fundamental construct in social cognitive theory. It is defined as an individual's belief in their ability to effectively implement the behaviour needed to generate an outcome (Bandura, 1977). Self-efficacy determines whether the target health behaviour will be carried out, particularly in the face of overcoming barriers (Bandura, 1977). For example, an obese individual may strongly believe that they have the ability to change their eating behaviour over the next month to achieve desired weight-loss results; and therefore intend to adjust their eating habits throughout their day.

According to social cognitive theory, self-efficacy can be promoted through verbal persuasion, vicarious experiences, performance accomplishments and psychological states (Bandura, 1977). Verbal persuasion can act as a double edged sword. Hearing stories of positive and successful behaviour can influence an individual's self-efficacy, however hearing negative stories can deteriorate any progression that has occurred (Bandura, 1977). Another method of developing self-efficacy is by viewing others successfully complete their tasks or reach their goals, otherwise known as vicarious experiences (Bandura, 1977). Performance accomplishments are a reflection of individuals' previous success with the behaviour and are used as a source of motivation and increased self-efficacy (Bandura, 1977). Finally, emotional arousal may cause a decrease in self-efficacy as the individual may be centred on avoidance and withdrawal behaviour (Bandura, 1977). Bandura (1977) expands on this indicating that individuals judge their arousal based on their assessment of the initiating conditions. As a result, arousal occurring in circumstances that are perceived to be of a threatening nature, are construed as fear resulting in loss of value to the objective (Bandura, 1977).

Theories of Reasoned Action and Planned Behaviour. The theories of reasoned action and planned behaviour are also social cognitive theories that examine relations between an individual's behavioural and social beliefs regarding a specific behaviour, intentions to perform the behaviour, and actual behavioural engagement (Ajzen & Fishbein, 1980). According to the theory of reasoned action, the likelihood of an individual undertaking behaviour is based on their intention to undertake the behaviour (Ajzen & Fishbein, 1980). Intentions reflect how much an individual wants to reach a goal and how much effort they are willing to contribute to achieve the behaviour (Ajzen, 1991). Ajzen (1991) indicates that there is a direct

relationship between the intention and an individual's behaviour. Intentions are a function of attitudes and subjective norms with respect to the behaviour (Ajzen, 1991). Attitudes are an individual's belief that participation in the behaviour will result in an outcome, evaluated as positive or negative (Hagger, Chatzisarantis, & Biddle, 2001). Subjective norms reflect an individual's estimate of the degree that significant others would want them to participate in the behaviour (Ajzen & Fishbein, 1980; Hagger et al., 2001). Research has illustrated that the theory of reasoned action accounts for a substantial proportion of variance in behaviour including health behaviour (Albarracin, Johnson, Fishbein, & Muellerleile, 2001; Fishbein, 2008).

A limitation of the theory of reasoned action is that the model does not explain behaviour that an individual perceives as difficult to change or behaviour that has significant perceived barriers, which could prevent behaviour engagement even when the attitudes and social norms support the behaviour (Ajzen & Fishbein, 1980). Beliefs about the control an individual has over their behaviour may account for perceptions of perceived difficulty and barriers, is not considered in the theory of reasoned action (Ajzen & Fishbein, 1980). To incorporate these elements, the theory of reasoned action was modified, leading to the development of the theory of planned behaviour (Ajzen, 1991).

The theory of planned behaviour is an extension of the theory of reasoned action, and considers behaviours that are not in an individual's volitional control (Ajzen, 1991). In the theory of planned behaviour, perceived behavioural control is included as an additional predictor of intentions (Ajzen, 1991). Perceived behavioural control reflects individuals' perception of the difficulty in performing the behaviour of interest (Ajzen, 1991). Perceived behavioural control is likened to

self-efficacy as it reflects an individual's perceived abilities to engage in the behaviour when faced with perceived challenges or barriers (Ajzen, 1991). For example, the more an obese individual thinks they can exercise in the face of barriers such as bad weather or lack of ability, the higher the likeliness of them participating in that behaviour. Previous research indicates that the theory of planned behaviour is generally successful in explaining the intention and frequency of performing different health behaviours (Armitage & Conner, 2001; Blanchard, Courneya, Rodgers, Daub, & Knapik, 2002; Godin & Kok, 1996; Sheeran, Conner, & Norman, 2001).

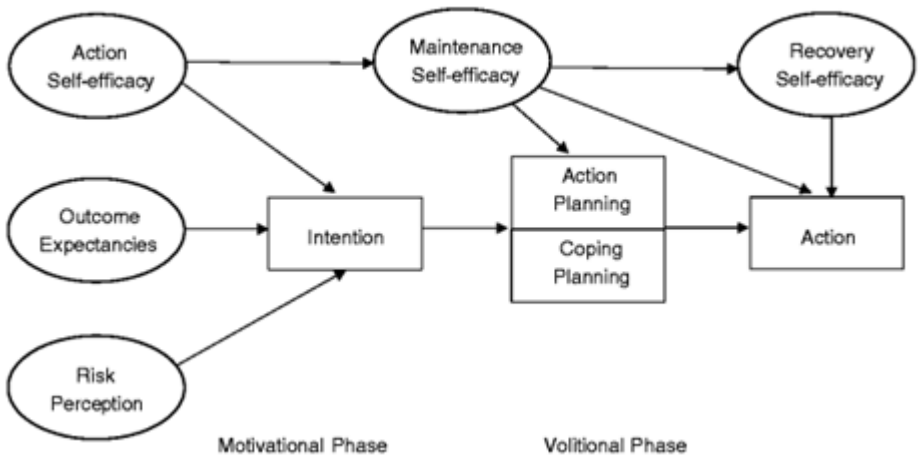
Action Control Theory. Kuhl's (1984) theory of action control outlines that an individual can have high self-efficacy and strong intentions to perform a behaviour but may still not act on their intentions due to insufficient self-regulatory capacity. Kuhl (1984) explains that action control refers to processes that assist the performance of intended actions. These processes assist in maintaining intentions to achieve a difficult goal and protect the intention from opposing action tendencies; the processes include attention control, motivation control and emotion control (Kuhl, 1984). Action control theory is supported by several experiments and empirical research (Heckhausen & Gollwitzer, 1987; Kuhl, 1984; Rhodes, Fiala, & Nasuti, 2012). Heckhausen (1991) introduced the Rubicon model which consists of four stages: intention formation, post-decision, action, and evaluation. The model proposes the transition from the motivational state to the volitional state that accounts for an individual's cognitive functioning (Heckhausen & Gollwitzer, 1987). The authors discuss two phases of an individual's decision making process. The first, known as the predecisional phase, explains how an intention to perform a particular action becomes established, otherwise referred to as a motivational phase; the second

phase is referred to the postdecisional phase, also known as a volitional phase (Heckhausen & Gollwitzer, 1987). During the predecisional phase, individuals are thought to deliberate on the possibility and appeal of relevant outcomes (Brandstätter, Heimbeck, Malzacher, & Frese, 2003). This is similar to Ajzen's (1985) theory of planned behaviour, where an individual's intention is a central influence in performing a given behaviour. Research suggests that intentions alone do not always lead to behaviour change; individuals do not always act on their intentions and this has been referred to as the 'intention-behaviour gap' (Barg et al., 2012; Prestwich, Perugini, & Hurling, 2010). The effect of planning outcomes on behaviour are assumed to be facilitated by action control. According to Sniehotta, Scholz, and Schwarzer (2005), the effect of introducing planning into theories of social cognition such as the theory of planned behaviour are aimed at 'bridging' the intention-behaviour gap. Planning is proposed to affect action control, as well as serving as an important prompt for other self-regulatory processes such as self-monitoring, resulting in individuals enacting their plans (Scholz, Sniehotta, & Schwarzer, 2005).

Health Action Process Approach. The health action process approach integrates concepts and hypotheses from; social cognitive theory, the theories of reasoned action and planned behaviour, and action control theory to explain health behaviour change (Schwarzer & Luszczynska, 2008). According to Schwarzer and colleagues (2003, p. 2), "the Health Action Process Approach (HAPA) is a social-cognition model of health behaviour suggesting that health behaviour change is a process that consists of a *motivational phase* and a *volitional phase*." The motivational phase leads to behavioural intention, and the volitional phase leads to actual health behaviour change (Schwarzer, 2008). Unlike the theories of reasoned

action and planned behaviour, the HAPA does not assume that intentions are the most proximal predictor of behaviour change (Schwarzer & Luszczynska, 2008). The HAPA addresses the intention-behaviour gap by incorporating post-intentional mediators of behaviour (Schwarzer & Luszczynska, 2008). Similar to the action control theory, the HAPA uses preintentional motivation resulting from risk perception, perceived self-efficacy and outcome expectancies (Schwarzer et al., 2003). The HAPA proposes that when an individual has formed an intention, action planning can assist in linking the gap between intention and behaviour (Schwarzer et al., 2003). These action plans will be discussed at a later stage. Figure 1.1 shows an illustration of the HAPA (Schwarzer, 2008). Schwarzer (2008) explains that in the motivational phase, the factors that contribute to intention formation are outcome expectancies, action self-efficacy, and risk perception. Schwarzer (2008) continues to explain that within the volitional phase there is a planning stage; the second phase of the HAPA model.

Figure 1.1. Health Action Approach Model



The factors contributing to the intention formation within the motivational phase are defined. Outcome expectancies are important in the motivational phase as they increase an individual's motivation to perform the behaviour (Schwarzer et al., 2003). Outcome expectancies are described as the subjective beliefs about unforeseen events of an individual's behaviour with succeeding outcomes (Schwarzer et al., 2003). The HAPA also provides a distinction between multiple types of self-efficacy (Conner, 2008). Action self-efficacy (also referred to as task self-efficacy) is part of the motivational phase, while maintenance self-efficacy (also referred to as coping self-efficacy) and recovery self-efficacy operate in the volitional phase (Leventhal & Mora, 2008). Action or task self-efficacy reflects an individual's belief that they will be able to successfully engage in the behaviour and produce desired outcomes by acting, increasing the likelihood of initiating a new behaviour (Schwarzer, 2008). For example, an individual may be confident in their ability to perform physical activity. Maintenance and recovery self-efficacy will be defined within the volitation phase in which they operate. When changing behaviour, the outcomes that are viewed as positive with minimal negative consequences influence an individual to form an intention that is in line with the target behaviour (Schwarzer, 2008). Risk perception is described as a set of beliefs an individual contemplates when considering the consequences and competencies of certain behaviour (e.g. "I am at risk for cardiovascular disease") (Schwarzer, 2008).

The planning aspect of the second phase in the HAPA model refers to both action planning and coping planning. Action planning is the formation of detailed plans which specify when, where and how the behaviour will be performed; coping planning is the process of imagining barriers that may get in the way of the goal and planning ways to overcome them (Schwarzer, 2008). Planning within the HAPA is

seen as a continuous process, where the depth of explanation of planning cognitions may vary (Schwarzer et al., 2003). For example, an individual may have already made the plans to go to the gym, but has not yet decided when to go, indicating that the components of planning such as when, where and how are measured by different items (Schwarzer et al., 2003).

As discussed, action or task self-efficacy is the perceived capability of a person to implement a certain behaviour (Schwarzer et al., 2003). Bandura (1994) suggests that the stronger the perceived self-efficacy for a behaviour, the higher the goal challenge that an individual sets for themselves and the firmer their commitment to the behaviour. A statement regarding the target behaviour or the behaviour change is located in the core of a task self-efficacy item (Bandura, 1994). Maintenance or coping self-efficacy illustrates optimistic beliefs about an individual's ability to handle barriers that appear throughout the maintenance process (Bandura, 1994). For example, new health behaviour might be more difficult to maintain than anticipated, and a self-efficacious individual is more likely to identify and select better strategies, invest effort, and persist in overcoming such hurdles. Recovery self-efficacy expresses an individual's confidence to resume the behaviour after being disrupted. In this scenario, an individual believes in his or her ability to regain control after a setback (Bandura, 1994).

The HAPA is supported by empirical research (Barg et al., 2012; Sonia Lippke & Plotnikoff, 2012; Schwarzer et al., 2003). The HAPA is used in health enhancing and preventative behaviours, risky lifestyles and addictive behaviours research, resulting high in reliability and validity in several applications of the theory within the research (Schwarzer et al., 2003). For example, Barg and colleagues' (2012) study examining predictors of physical activity has shown that the main

hypotheses relating to the prediction of the HAPA are supported; action self-efficacy and outcome expectancies significantly predicted intentions, and intentions and maintenance self-efficacy significantly predicted planning. In summary, the HAPA proposes that when an individual has formed an intention, action planning can assist in linking the gap between intention and behaviour (Schwarzer et al., 2003). The HAPA will be used as the basis of the current research incorporating strategies to promote behaviour change in both the motivational and volitional phases. To target the necessary dietary intake and physical activity behaviours for weight-loss, the present study will incorporate the combined use of two strategies, mental imagery and implementation intentions, as they are proposed to change constructs in the motivational and volitional phases, respectively, of the HAPA.

Intervention Planning Techniques: Mental Imagery and Implementation Intentions. Mental imagery and implementation intentions are two separate intervention techniques that have been shown to be effective in assisting with goal attainment (Andersson & Moss, 2011; Knäuper et al., 2011; Knäuper, Roseman, Johnson, & Krantz, 2009). Mental imagery and implementation intention strategies and their relation to theoretical constructs from the HAPA will be discussed separately, followed by a discussion of the combined use of these strategies to change health related behaviour.

Mental imagery. Research has shown that improved success for goal achievement can be attained through the use of mental imagery (Knäuper et al., 2011). Individuals can use imagery to create mental images of an imagined object, situation, action, and emotions by mentally mimicking motor, perceptual, and emotional experiences using a number of sensory modes including vision (Atance & O'Neill, 2001; Lang, 1979; Moran, 2004). Mental imagery can be categorised as

either outcome or process types, both having different implications for goal attainment (Knäuper et al., 2011). Outcome imagery is based on imagery related to the experience of goal achievement and success, and therefore is a motivational approach for improving goal achievement (Knäuper et al., 2011). Process imagery is based on imagery related to the steps needed to achieve the desired outcome, which according to Pham and Taylor (1999), is mainly a cognitive planning strategy (Hagger, Lonsdale, & Chatzisarantis, 2011). For example, if an individual's goal was to jog daily in the local park to lose weight, then outcome imagery may focus on the ability to exercise more comfortably and appearing slimmer, while process imagery may involve imagining the steps involved in the goal of jogging such as imagining the park environment and the physical sensations associated with jogging.

Bandura (1997) provides support for a relationship between efficacy beliefs and the use of imagery. Imagery is believed to be a source of self-efficacy; that is, imagining oneself performing behaviour correctly may increase an individual's confidence to engage in the behaviour. Self-efficacy can be derived from things such as vicarious experiences (related to viewing others successfully complete their tasks or reach their goals), and performance accomplishments (events that an individual successfully passes and are used as motivational and influential factors of self-efficacy) (Bandura, 1977). By imagining oneself as successful in an upcoming situation and viewing oneself complete the tasks needed for goal attainment with successful performance, efficacy beliefs can be formed; this concept is referred to as cognitive self-modelling (Bandura, 1977). These efficacy beliefs then influence future behaviour and performance in a situation. Bandura (1977) suggests that self-efficacy influences one's motivation towards engaging and persisting in a behaviour action.

The HAPA outlines various types of self-efficacy and how they relate to behaviour change (Conner, 2008). According to the HAPA, action or task self-efficacy appears to be enhanced through mental imagery (Conner, 2008). For example, action self-efficacy relates to an individual's perceived capability to implement a certain behaviour, such as imagining oneself engaging in the task of jogging may increase confidence in one's ability to conduct the behaviour. That is, the individual imagines that they engage in the behaviour, thus acting like a 'self-model;' this reinforces the necessary actions needed to successfully engage in the behaviour change and enhances the individual's self-efficacy or confidence that they can perform the behaviour. This relates to the motivational phase of the HAPA, as self-efficacy is a factor that contributes to intention formation (Schwarzer, 2008).

It is important to consider an individual's ability to use imagination as it may confound the effectiveness of interventions using imagery techniques (Andersson & Moss, 2011). For this reason, it is necessary for researchers to examine the contribution of an individual's ability to use imagery on successful behaviour change and on the outcome measures related to intervention efficiency.

Implementation intentions. The HAPA highlights the need for action planning to assist with behaviour change (Schwarzer, 2008). Action planning refers to the formation of detailed plans of when, where and how behaviour will be performed. Implementation intentions are a specific form of these action plans, which are 'if-then' plans that state *when, where,* and *how* one intends to reach a behavioural goal (Gollwitzer, 1999). Implementation intentions have a formation of 'If situation *x* arises, I will perform response *y.*' For example, the intention to exercise by riding one's bike could be written as an implementation intention: "*If* I see my bike at home before I go to work, *then* I will use my bike to get to work

(completion of goal).” Webb and Sheeran (2007) suggested that these implementation intentions influence behaviour by increasing mental representations of a foreseen environmental cue (for example, seeing ones bike). Also, implementation intentions enhance the relationship between planned situations (leaving the house) with goal-directed response (riding the bike to work). This leads to increased likelihood of engaging in the behaviour when coming across the planned situation reducing the intention-behaviour gap. This is due to increased salience of that cue and the accessibility of the associated action in one’s memory.

Sheeran, Webb and Gollwitzer (2005) reported that intention-behaviour discrepancies occur when intentions are not complemented with details of when, where, and how the intentions can be performed. This highlights the use of forming implementation intentions to assist with goal achievement. Furthermore, Allan, Sniehotta, and Johnston (2013) found that a planning intervention (implementation intentions) significantly improved goal attainment in individuals who were poor planners. The authors suggest this strategy is also helpful for skilled planners who already have the skills to achieve their goals.

Combined use of mental imagery and implementation intentions. Mental imagery and implementation intentions are two different techniques that have been found to lead to behaviour change in the dietary intake and physical activity domains. Research provides support for the use of mental imagery in controlling the effectiveness of implementation intentions where individuals instructed to use mental imagery when creating implementation intentions improves goal achievement (Knäuper et al., 2009). Also, research has found support for the use of implementation intentions in combination with mental imagery to increase engagement in target behaviour (Andersson & Moss, 2011; Knäuper et al., 2011;

Knäuper et al., 2009). For example, Knäuper and colleagues (2011) studied the relationship between implementation intentions and process mental imagery on students allocated the goal of increasing fruit consumption for a seven day period. The researchers hypothesised that the combination of implementation intentions and mental imagery will be most effective for goal achievement, compared to receiving no intervention, implementation intentions, or mental imagery only; the combination of implementation intentions and mental imagery techniques were predicted to enhance motivation and also facilitate volition (Knäuper et al., 2011). That is, converting intentions into behaviour through planning. In the HAPA, self-efficacy is increased through the use of mental imagery in the motivational phase, while planning is increased through the use of implementation intentions in the volitional phase (Schwarzer, 2008). The study by Knäuper and colleagues (2011) found support for the use of mental imagery targeted at implementation intentions among individuals whom are not engaging in eating the recommended daily fruit intake. Knäuper and colleagues (2011) suggest that mental imagery increased cognitive access to critical cues and strengthened cue response links. Research suggests this access to cues and links may mediate the effects between implementation intention and goal achievement (Webb & Sheeran, 2007). Andersson and Moss (2011) have also found that both guided mental imagery and implementation intentions increased physical activity compared to the control condition. In summary, mental imagery and implementation intentions are effective in combination for goal attainment (Andersson & Moss, 2011; Knäuper et al., 2011; Knäuper et al., 2009). The current research proposal will incorporate the combined use of mental imagery and implementation intention strategies to change health related behaviour as the

constructs relate to the motivational and volitional phases, respectively, in the HAPA (Schwarzer, 2008).

Promote Engagement with Planning Techniques: Text Message Reminders. A widely-available and cost effective tool that has been recently applied to promote health behaviour change is mobile phone text messaging (Cole-Lewis & Kershaw, 2010). Support for the use of text messages for increasing intervention effectiveness has been found in various studies exploring the outcome of weight-loss (Haapala, Barengo, Biggs, Surakka, & Manninen, 2009; Patrick et al., 2009; Prestwich, Perugini, & Hurling, 2009; Prestwich et al., 2010). For example, Prestwich and colleagues' (2010) study aimed to promote brisk walking among sedentary individuals, and found that pairing implementation intentions with goal-reminder text messages assisted participants in improved walking behaviour and weight-loss. The study explored implementation intentions and receiving text messages of reminders of either one's plans versus goals. In comparison, the participants in the text message goal-reminder condition were more successful in goal recall, and the participants in the text message reminder condition were better able to recall their plans. Prestwich and colleagues (2010) found that during the 4 week intervention period, the goal-reminder condition lost more weight compared to the plan reminder condition and the control condition. The researchers suggest that the goal text messages reminded participants of their goals, and thus both activated behaviour intentions to walk briskly, and may have also promoted other actions that influence weight such as to avoid snacks (Prestwich et al., 2010). The current research proposal will incorporate the use of goal-reminder text messages to promote health behaviour change aimed to increase the interventions effectiveness.

Online intervention delivery method. The use of the internet to deliver health behaviour interventions has numerous advantages including widespread access, cost effectiveness, and ease of use. The most common reason for examining the use of internet based interventions is the low delivery cost and reduction in reliance on health services (Griffiths, Lindenmeyer, Powell, Lowe, & Thorgood, 2006; Tate, Finkelstein, Khayjou, & Gustafson, 2009). Once an online based intervention is created, the intervention requires minimum input and resources by health care professionals to administer the intervention components to the clients; the client can be directed to the self-help online program that provides psycho-education and other information (Griffiths et al., 2006). It is acknowledged that such interventions are not a substitute for face-to-face contact, (Griffiths et al., 2006); however the method may assist with reducing the frequency of contact needed with a health care professional.

The adaptation of an online intervention delivery method for study trials also provides an advantage in that the presented information will be conveyed in a consistent manner among the intervention conditions and experimenter bias is significantly reduced. In addition, the delivery method allows for integration of administering health behaviour instructions and activities, as well as questionnaires within the online intervention. Completing intervention activities online provides the participant and researcher with the option of accessing the responses instantly (example, through the use of email). A benefit of administering questionnaires online is the ability to prompt participants to complete any missing items prior to questionnaire submission, hence reducing missing data.

The current study will adapt an online intervention delivery method in an attempt to increase the intervention's applicability to the real world setting. Health

professionals will have the means of assisting overweight and obese individuals seeking weight-loss assistance, through providing the individual with access to the online evidence based self-help approach. In addition, future developments could mean that individuals will have the flexibility to access the self-help intervention program at a time of their own convenience.

The Present Thesis and Significance

Weight-loss may prevent or decrease risk of overweight and obese individuals from developing psychological and physiological problems (WHO, 2012). Researchers have demonstrated that intervention effectiveness is increased with the use of a theory-based intervention (Michie & Johnston, 2012). The purpose of the current study was to change dietary intake and physical activity behaviours, and promote weight-loss and reduction of obesity-related health risk factors in a sample of overweight and obese individuals. The present thesis examined the use of mental imagery and implementation intention targeted at the dietary intake and physical activity recommendations in order to promote adherence with the dietary intake and physical activity behaviour changes.

The proposed study involved the development, pilot, implementation, and evaluation of the brief theory-based intervention. The intervention was delivered via a video presentation integrated within an online system using the Qualtrics™ program accessed through the internet, rather than by a clinician. In addition, the present study evaluated whether mobile phone goal-reminder text messages were effective in augmenting the effectiveness of the intervention. The present study evaluated the effectiveness of the intervention on changes in behavioural, biomedical, and psychological health related outcomes and measures.

The intervention in the current study was based on theories of motivation and decision making. This is important as research has shown that few interventions in the health behaviour context are theory-based, particularly those using text messaging (Cole-Lewis & Kershaw, 2010). This is a limitation in the field as research has suggested that intervention effectiveness is increased when theory guides the intervention design demonstrating the present studies significance (Michie & Johnston, 2012). In addition, the significance of implementing a theory-based intervention via video means that the intervention is evidence based, cost effective, requires minimal contact, provides flexibility for delivery, and is easily available.

The current research investigated the effectiveness of the 12-week HEALTHI (Healthy Eating and Active LifesTyle Health Intervention) program, a theory-based intervention based on the HAPA, using implementation intentions and mental imagery techniques to target dietary intake and physical activity behaviour in order to promote weight loss. Previous research has found that the combination of implementation intention and mental imagery assists with improving behavioural outcomes in health-related intervention studies (Andersson & Moss, 2011; Knäuper et al., 2011; Knäuper et al., 2009). The current study also examined the use of these strategies, and in addition evaluated whether mobile phone goal-reminder text messages are effective in augmenting the intervention effectiveness. The specific objectives of the current research were:

- Development, pilot, implementation, and evaluation of the proposed intervention using a randomised-controlled design in a sample of overweight and obese adults recruited from the community. The three study conditions were: (1) a psycho-education plus an implementation intentions and mental imagery condition; (2) a psycho-education plus an implementation intentions

and mental imagery condition with text messages; or (3) a psycho-education weight-loss condition.

- Evaluation of the effectiveness of the intervention on changes in behavioural (physical activity and dietary intake), biomedical (e.g., blood pressure, blood cholesterol, and body weight), and psychological (e.g., quality of life, motivation, and self-efficacy) health related outcomes and measures. The study identified whether the intervention conditions that include implementation intentions and mental imagery components, led to significantly greater weight-loss, compared to the psycho-education weight-loss condition. In addition, the study examined whether an intervention which combines implementation intentions and mental imagery with text messages, would have more significant weight-loss, compared to the implementation intentions and mental imagery condition and psycho-education weight-loss condition.
- Identification of the psychological constructs from the HAPA that act as mediators of the effect of the intervention components on the behavioural and biomedical outcome variables such as: self-efficacy, motivation, outcome expectancy, and planning variables using validated self-reported measures. The variables were measured to provide an understanding of the components responsible for change, or the 'active ingredients' of the intervention.

Overview of Thesis Studies and Content

The current research aimed to develop and evaluate the HEALTHI program, and to test the predictions of the HAPA. This thesis consists of seven chapters. The

current chapter provided a review of the literature including the theoretical framework that guided the key components of the HEALTHI program. Chapter two will provide an overview of the program development and pilot of the program through the use of two focus group sessions, including descriptions of a thematic analysis that led to the ideas underlying the program's amendments contributing to the finalisation of the HEALTHI program. Chapter three includes an overview of the study protocol. Chapter four consists of the HEALTHI program's implementation in an overweight and obese sample and the evaluation of the weight-loss program within the community; this chapter includes a discussion of the effects of the intervention on the study outcomes including an overview of the methodology, assessments, statistical analysis, and results. The chapter also includes the examination of the mediation of the intervention by the HAPA variables. Chapters five and six examine the prediction of change in biomedical, psychological and behavioural outcome variables based on changes in the HAPA variables. The HAPA variables examined include; action and maintenance self-efficacy, outcome expectancy, risk perception, motivation, planning, and behaviour. Finally, Chapter seven includes; a discussion of the results and their implications in the 'real world,' the limitations of the studies, and areas for future research.

CHAPTER TWO: Development and pilot of the HEALTHI

Introduction to the Development and Pilot of the HEALTHI program

This chapter will provide an overview of the program development and pilot of the HEALTHI program, the content of the intervention components of the program aimed at behaviour change, as well as the weight-loss education information provided to all the intervention conditions including the psycho-education weight-loss condition. This process consisted of three stages. The first stage included the selection of an evidence-based weight-loss method, and health behaviour-change methods related to dietary intake and physical activity. This process was enhanced through the development of a table outlining the details of the behaviour change techniques that were used in the intervention and their relation to constructs from the HAPA (Michie & Abraham, 2008; Michie & Johnston, 2012). Based on this table, a draft version of the weight-loss intervention was developed; the written script contained the information that was verbally presented in video format. The draft version of the intervention was then recorded for pilot purposes, which involved filming the researcher presenting the information, and incorporating written information in the form of slides within the video using the Video Intervention Editing software. The second stage involved the facilitation of two focus group sessions to gain feedback on the intervention process, leading to a thematic analysis of the data. The third stage consisted of redevelopment of the weight-loss intervention based on the focus group feedback received, and the researcher presenting the information to re-record the intervention to a professional level. The intervention was then viewed by two expert academic reviewers and two members in

the community, and feedback was received prior to the intervention's approval to be used for the study's clinical trial.

Stage One: Weight-loss and Health Behaviour Change Methods

The program intervention was designed to recommend behaviour change in the area of dietary intake and physical activity in order to assist with weight-loss and the reduction of obesity-related risk factors in overweight and obese individuals. The intervention was based on two primary weight-loss recommendation guidelines to which participants were required to adhere to in the intervention. The decision for the current study's two recommendations was based on the information outlined in the thesis literature review (*see* Chapter 1, "weight-loss" section). Participants in the present study were asked to adhere to the basic principles of the below two guidelines, in the area of physical activity and dietary intake, respectively.

Physical activity weight-loss guideline. The physical activity weight-loss guideline is to be as physically active as possible and to engage in a minimum of 30 minutes of planned daily exercise; this guideline is in accordance with the Australian Physical Activity and Sedentary Behaviour Guidelines (Department of Health, 2014). This recommendation is also consistent with the physical activity guidelines in America (and Australia) which recommend that adults engage in a minimum of 30 minutes of moderate activity on most or all days of the week to receive health benefits (Norton et al., 2010). Participants were informed that more intensive exercise will assist them in reaching their weight-loss goal. To assist participants with adhering to physical activity and planned exercise, all participants were provided with the weight-loss psycho-education component of the intervention via the video presentation and program summary handout (*see* Appendix B for the draft

version of the intervention script). The psycho-education component included information on; benefits for physical activity, exercise examples, how to engage in exercise, how to monitor physical activity levels, and information on the Australian Physical Activity and Sedentary Behaviour Guidelines. A copy of the Australian Physical Activity and Sedentary Behaviour Guidelines was provided to all participants. The participants were asked to keep track of their daily physical activity using diaries that were provided to them.

Dietary intake weight-loss guideline. The dietary intake weight-loss guideline was to monitor energy intake and ensure the individual's calorie (or kilojoule) intake was between their minimum and maximum daily allowance. Each participant was provided with their individual recommended daily calorie intake needed for weight-loss. The Katch-McArdle Formula was used to calculate the minimum amount of energy needed for one's body to function, or the calories needed to maintain one's weight, referred to as basal metabolic rate, (BMR; Boston, 2013). The Katch-McArdle formula takes into consideration an individual's lean body mass. The formula considers an individual's age, height, and weight measurements (BMR = 370 + (21.6 x lean mass in kg). Total daily energy expenditure was calculated by multiplying the BMR to a number representing the individual's physical activity level; the numbers for the various physical activity levels are listed specifically for use with the Katch-McArdle formula (*see* McArdle, Katch, & Katch, 2006). The outcome of the above is subtracted by 500 calories to provide individuals with the recommended number of calories that they are to consume to achieve weight-loss (Fernau, 2010). A minimum energy intake allowance was set to 5021 kilojoules (1200 calories) and 6276 kilojoules (1500 calories) respectively for females and males (Anderson, 2004). Individuals were informed that it is essential not to eat

fewer calories than the recommended amount as this can lead to negative consequences, such as lowered metabolic rate, fatigue and lack of energy (Anderson, 2004; Melani, 2002; Rodriguez, 2011).

Participants' calorie intake allowance was recalculated at week 6 to incorporate body weight changes which impact on the required calorie requirement allowance. To assist participants in staying within their daily recommended caloric intake, participants were provided with the weight-loss psycho-education component of the intervention via the video presentation and a program summary handout (*see* Appendix B for the draft version of the intervention script). This included; information on how to calorie count, how to use a calorie counting book, suggestions on food and drink consumption to assist in remaining within the daily calorie or kilojoule allowance amount, how to ensure a healthy diet including information on the Australian Dietary Guidelines (2013), and examples of healthy eating. A copy of the Australian Dietary Guidelines was provided to all participants. The participants were asked to keep track of their daily calorie intake using diaries that were provided to them.

Individuals were required to consume the recommended daily calories to lose weight and follow a healthy diet. Adherence to the Australian Dietary Guidelines (2013) was suggested, which recommend that an individual limits foods containing saturated fat, added salt, added sugar, and alcohol. In addition, the Australian Dietary Guidelines recommend that each day an individual eats sufficient portions of foods from the five categories listed:

1. Vegetables (including different colours and types) and legumes or beans.
2. Fruit.

3. Grain foods, especially wholegrain or high fibre cereals, such as bread, rice, pasta, and cereal.
4. Lean meat and poultry, fish, eggs, tofu, legumes or beans, nuts and seeds.
5. Milk, cheese, yogurt, and/or their alternatives, with reduced fat and low sugar the recommended preference.

In addition, the Australian Dietary Guidelines recommend that to maintain a healthy diet it is essential to drink sufficient water. The guidelines suggest adults drink an average of 2.6 litres of water for males and 2.1 litres of water for females, with the majority of intake as plain water. The Dieticians Association of Australia (2014) suggests adults should aim for approximately 1.5 to 2 litres per day of water. The current weight-loss program herein suggested that participants aim for 2 litres of plain water per day.

Behaviour Change Techniques

Research recommends that an effective weight-loss method should include a combination of a calorie restricted diet and physical activity (Anderson, 2004; Foreman, 2009). In order to assist participants in adhering to these weight-loss guidelines and engaging in the dietary energy intake and physical activity behaviour changes, the use of behaviour change techniques were considered. The intervention adopted the HAPA (Schwarzer, 2008; see Chapter 1) to identify the components related to changes in weight-loss behaviours and how components can be used to inform the intervention content to ensure the change process is clearly identified.

The HAPA states that the process of health behaviour-change comprises a motivational phase that leads an individual to form the intention to change their

behaviour, and a volitional phase that leads the individual to performing the actual behaviour (Schwarzer, 2008). Implementation intentions and mental imagery relate to the HAPA phases. Implementation intentions promote action planning, bridging the gap between having the intention to change behaviour and performing the behaviour, consistent with the HAPA volitional phase (Gollwitzer, 1999). Mental imagery has been found to increase an individual's self-efficacy to change their behaviour, which relates to the motivational phase in the HAPA.

The combined use of implementation intentions and mental imagery have been found to be effective in changing dietary intake and physical activity behaviours for weight-loss (Andersson & Moss, 2011; Knäuper et al., 2011; Knäuper et al., 2009). In addition, mobile phone text messaging is a widely available, cost effective, and instant tool applied to promote health behaviour-change and has been used to increase intervention effectiveness (Cole-Lewis & Kershaw, 2010). Support for the use of text messages to increase intervention effectiveness is found within various studies exploring the outcome of weight-loss (Haapala et al., 2009; Patrick et al., 2009; Prestwich et al., 2009; Prestwich et al., 2010).

Intervention Content Matched with Theory

Researchers highlight the importance of outlining details of the behaviour change techniques used in relation to how they fit the theory (Michie & Abraham, 2008; Michie & Johnston, 2012). This allows for an understanding of the content that an intervention uses, the methods, and the 'active ingredients' that lead to behaviour change. Michie and Prestwich (2010) also highlight the importance of not only using theory to guide an intervention, but also identifying the theory components that relate to the intervention techniques. Chapter three (Table 3.2) will provide details of the

systematic method of matching the study techniques with the theoretical components; this allows for better understanding of how the theory informs the intervention design and assists in evaluating the effectiveness of the intervention and theory (Bartholomew, Parcel, Kok, & Gottlieb, 2001; Michie & Prestwich, 2010).

Video Presentation Instructions and Intervention Delivery. A detailed video presentation was developed to provide participants with study information, instructions, and intervention delivery. The idea behind this delivery mode is that two versions of the video presentation are developed. The main components of the video presentation are outlined below. For more detailed information, Appendix B provides a draft script of the content that was included within the draft version of the weight-loss program's video presentation.

The pre-recorded weight-loss program video presentation created for all intervention conditions, (including the psycho-education weight-loss condition participants), included general information such as the study details, and psycho-education regarding the dietary energy intake and physical activity guidelines consistent with the weight-loss intervention. Participants received information such as; the definition of a calorie, how to calorie count, which exercises are more intensive, tools to assist with monitoring physical activity and calorie intake (e.g., calorie counting book), how to record consumed calories and physical activity via a provided food and exercise log book, and examples of goals related to the dietary energy intake and physical activity guidelines. The presenter of the video presentation instructed participants to list some goals to assist them in meeting the dietary energy intake and physical activity guidelines. The goals were submitted to the researcher and a copy made available for the participant. A copy of the Australian Dietary and Physical Activity Guidelines was provided to all participants to take

home. In addition, a handout providing essential program information such as the guidelines and the participants' responses to the activities (including goals formulated) were emailed (or mailed) to all participants.

The pre-recorded video presentation shown to participants in the two intervention conditions (of implementation intentions and mental imagery with and without text messages) consisted of the exact information to that of the psycho-education weight-loss condition. However, the video presentation shown to participants within the intervention conditions also included instructions and examples for mental imagery and implementation intentions techniques. Participants in the intervention conditions were provided with instructions to guide them to mentally imagine the steps needed to reach their goals. The intervention condition participants were instructed to create implementation intention plans using an 'if-then' format. Also, intervention condition participants were directed to record their goals, 'if-then' plans, and mental imagery steps. A handout providing essential program information such as the guidelines and the participants' responses to the activities (including goals formulated, if-then plans, and mental imagery steps) were emailed (or mailed) to the participants.

The use of a video presentation provided the researcher with greater control over potential confounding variables in the delivery of information. That is, all participants received the same content in relation to study design, psycho-education information, dietary energy intake and physical activity guidelines, and information on how to calorie count. Participants within the implementation intentions and mental imagery, and implementation intentions and mental imagery with text messages conditions also received the same information regarding the mental imagery and implementation intentions instructions, and thus differences in the

intervention conditions can be attributed to the goal-reminder text messages and not differences in intervention delivery style. For the purpose of piloting the intervention it was decided that the video presentation that included the intervention manipulations was used for testing purposes in the focus group sessions.

Text message intervention component. Participants in the implementation intentions and mental imagery with text messages condition, received a text message once a week for a total of twelve weeks. The text message content included non-personalised and generalised goal reminders that prompts the participant to reflect on their dietary energy intake and physical activity goals, implementation intentions and mental imagery. For example: “Hello. I would like to ask you to take the time to review and remember your goals and the steps you need to take to reach them. Try and remember (or refer to your HEALTHI program handout) when you imagined the steps for your diet and exercise goals when watching the video? Take a few minutes to imagine these steps to reach your goals so it is clear in your mind.”

Stage Two: Focus Groups and Thematic Analysis

Stage two consisted of the researcher facilitating two independent focus group sessions to provide feedback on the intervention process; this information was examined using a thematic analysis. The aim of the focus group sessions was to pilot the program prior to its use for the clinical intervention; the focus groups were designed as a means to receive the feedback of both community and health professionals in the areas of intervention design, modification and examination of the intervention components in an attempt to enhance the intervention quality. The aim of the thematic analysis was to explore themes identified from the focus group

sessions feedback and use the data to facilitate program amendments. The process is outlined in the next sections.

Introduction to Focus Groups and Thematic Analysis

The draft version of the video intervention was developed and recorded for pilot purposes. Two focus group sessions were held at Curtin University to obtain feedback on the intervention content. Focus group 1 invited feedback from individuals within the community. Focus group 2 invited feedback from individuals within the relevant health profession. The focus group sessions were conducted to clarify whether the information was appropriate for the target group (such as the amount of dietary energy intake and physical activity information) and to ensure the intervention instructions were clear and easy to understand. In addition, the process of reviewing the resources and messages was to ensure that the intervention is relevant. This approach of engaging members of the community and health professionals in the intervention design, modification and testing of the intervention components was believed to enhance the quality of the intervention.

The objective of the thematic analysis was to explore the concepts and themes in relation to the weight-loss intervention. The thematic analysis (Braun & Clarke, 2006) found central themes across the two focus group sessions and will be discussed later in the chapter. The methodology used and the implications of these findings is discussed below.

Method

Thematic analysis. Braun and Clarke (2006) outline the need to explicitly state the choices that a researcher decides when conducting a thematic analysis. The decisions that the current researcher made are outlined. Data codes and information that captured an important concept (whether it was prevalent across the data set or not) in relation to the overall focus group research purpose were set as a theme (Braun & Clarke, 2006). An inductive analysis approach was used and themes emerging from the transcripts were coded independent of pre-existing coding frameworks. That is, the analysis was data driven. Themes were identified at a semantic level, with the surface meanings of the data used and the researcher not looking beyond what the participant stated or wrote. This process involved the description of the data after it had been organised to show patterns within the semantic content. The information was then summarised and interpreted. The researcher also adopted an essentialist/realist approach with meaning driven from the motivations and experiences in a direct way, with the assumption that language is believed to reflect meaning and experience.

Participant recruitment and sample. Participants were recruited through liaising with community members and health professionals, both within the community and at Curtin University. In addition, the researcher drew on her social and professional network to assist in finding potential focus group participants. Efforts were made to have a representative sample of health professions working in the academic area (within and outside of Curtin University), private practice, and with various educational backgrounds including psychology, nutrition, and public health. Efforts for a representative community sample also took place, by inviting potential participants from various backgrounds (excluding the health profession)

including employed, unemployed, degree-qualified, non-degree qualified, white collar, and blue collar workers.

Potential participants were invited to attend a focus group session via an email, with an accompanying invitation letter. The email also requested that potential participants "please forward this email to anyone who you believe may be interested in participating" to allow for sample of convenience to increase access to a wider range of participants. The invitation letter also provided potential participants with information on the purpose of the focus group session. Participants were able to express their interest to attend the focus group session via email. Participant recruitment ceased after having receiving confirmation of the attendance of seven participants for each focus group session.

The health professionals focus group consisted of two male and five female participants, aged between 20 and 40, with body mass index (kg/m^2) ranging from 17.77 to 22.84. The participant's highest level of schooling was university or tertiary level, with the qualifications ranging from undergraduate psychology, to completed postgraduate studies in psychology (exercise, health, social, or clinical) or public health. One participant arrived a half hour late. Table 2.1 provides a summary of the participants' demographic information. The community focus group consisted of four female participants, between the ages of 27 to 56 years, and with a body mass index (kg/m^2) ranging from 20.55 to 30.57. The researcher confirmed the scheduled seven participants' attendance three days prior to the focus group date. However, one participant cancelled their attendance the day prior to the focus group session. Another participant cancelled their attendance on the day of the focus group. A third participant did not attend the session without reason. The participants' highest level of schooling ranged from completed high school to university level. The highest

level of qualification included, but was not limited to, a certificate of secretaryship, or university degrees (nursing, commerce, or science). One of the attendees left the focus group a half hour prior to the end time due to having an appointment booked that overlapped with the set session times. Table 2.1 provides a summary of the participants' demographic information.

Table 2.1

Focus participant demographic data in percentage or mean (standard deviation)

Variable		Health Professionals (n = 7)	Community (n = 4)
Gender	Female	71.4%	100%
	Male	28.6%	0%
Age		30.71 (6.99)	40.00(13.44)
Body mass index		20.73 (1.77)	24.85 (4.66)
Country of birth	Australia	28.6%	25%
	Belarus	14.3%	0%
	England	14.3%	0%
	Germany	14.3%	0%
	Malaysia	0%	25%
	New Zealand	0%	25%
	United Kingdom	28.6%	0%
	United States of America	0%	25%
Ethnic origin	Caucasian	85.7%	50%
	Asian	14.3%	25%
	Other	0%	25%
Highest level of schooling*	Completed high school	0%	25%
	University or tertiary level	100%	75%
Current employment status*	Full time	71.4%	100%
	Other: Part time work and study	28.6%	0%

**Note.* Some options were not listed in the table as participants did not provide any response.

Measures. Demographic information including gender, date of birth, body weight, height, highest level of schooling, and employment status was documented via a demographic information form (*see* Appendix C). In addition, height (m) measured to the nearest 0.1cm using a stadiometer, and body weight (kg) recorded using a digital body composition scale with participants wearing light clothing and no shoes was documented to calculate the focus group participants body mass index. Body mass index was calculated using the weight and height measurements, by means of the formula weight in kilograms divided by the square of the height in meters (kg/m2).

Procedure. The focus group sessions were conducted in a quiet room at Curtin University, and conducted by the principal investigator (referred to hereafter as the "researcher"). The researcher also presented the intervention information in the videos and when referring to the researcher in this context the term "presenter" will be used. The term "participant" will refer to the focus group participants. The term "intervention viewer" will be used to describe the overweight and obese individuals that the intervention is aimed for who will *view* the intervention after the intervention's redevelopment.

As the focus group participants arrived to the session, the researcher welcomed them to the focus group. All participants completed a demographic information and informed consent form with an invitation information sheet (*see* Appendix C and D). Participants were then taken aside to obtain height and weight measurements to record on their demographic information form. Participants were also provided with a written handout of the weight-loss intervention script and a pen to assist them with note taking relevant to providing feedback (*see* Appendix E). This document was collected following the completion of each focus group session. An

activity handout was also provided to participants, which contained the activities that the weight-loss intervention video directs the participants (and the intervention viewer) to complete (*see* Appendix E). Focus group participants were provided with the activity handout to review, however they were not asked to complete the activities.

A script that contained some study background information and instructions (*see* Appendix F) was read to the participants by the researcher. Participants provided verbal consent prior to the commencement of the session audio recording. The weight-loss intervention video was viewed in sections. Each video section was followed by a brief discussion of relevant research questions. The questions were established by the researcher, developed to ensure that the focus group sessions do not deviate from the intended purpose and to assist in exploring the issues relevant to the research questions. The questions related to the areas of the video intervention, including study information and psycho-education, exercise, diet, intervention, and other questions including, but not limited to questions on the slides, content, and presentation. Appendix F outlines the focus group script and the focus group research questions. The research questions were designed to provide session structure, but not rigorously direct the discussion areas. The researcher encouraged participants to expand on their responses using verbal and non-verbal prompts, whilst managing the time. The focus group sessions were 90 minutes in duration to provide adequate time to view the video presentation and engage in discussions. Following the completion of each of the focus group sessions, participants were thanked for their attendance. Some participants received a follow-up email to clarify missing data information, such as their date of birth.

Data analyses

Analysis phases. Data analysis was completed using Braun and Clarke's (2006) qualitative analysis guidelines. The six identified phases of the analysis were completed using a recursive process (working back and forth throughout the phases). *Phase 1:* The focus group data was transcribed into written form by the researcher. The researcher listened to each of the recordings several times to ensure transcription accuracy (Braun & Clarke, 2006). The audio recordings and transcription document was then given to a research assistant to check the transcripts against the audio recording. During the transcription process, the researcher took note of initial thoughts and ideas, and repeatedly read the transcribed data in the search for meaning. *Phase 2:* The coding phase consisted of exploring the notes and ideas evident as a result of the transcription and data immersion. The researcher allocated codes to all aspects of the data that appeared relevant to the focus group purpose. All of the data was given equal attention to ensure all repeated ideas within the data were examined. A manual coding method was employed involving typing the codes corresponding to the script using comments via track changes, printing and cutting the comments (or codes), and using highlighters, coloured pens, and post-it notes to organise, structure and make meaning of possible patterns. *Phase 3:* The codes were sorted into the potential themes. During this process some codes were collated to form an all-embracing theme. *Phase 4:* The themes were reviewed and refined. Themes that did not contain sufficient supporting data were discarded. As the purpose of the focus group sessions was to improve the interventions effectiveness, some themes that contained limited information remained, and were still held as important as they contribute to the research purpose. Theme refinement involved two levels. Firstly, ensuring the coded data formed a coherent pattern. With the formation

of the clear patterns, the next level involved consideration of how the themes fit the complete data set. This was to ensure that the themes reflected the whole data and not only segments (Braun & Clarke, 2006). The data set was then re-examined to ensure no codes had been previously missed. *Phase 5:* This phase involved the naming of the themes, with the theme names designed to capture the themes central idea. All themes were provided with a clear definition. *Phase 6:* The themes were documented, after re-reading the transcripts and relating various examples from the transcription document (quotes) that clearly illustrated each of the themes.

The researcher completed phase 1 to 6 based on the interview transcriptions. The script handout information (*see* Appendix B) that participants used to document notes was also reviewed. The information contained in the script document was verbalised during the focus group discussions thus overlapped with the transcription document. In addition, two emails were received from two focus group participants who provided additional thoughts post-focus group session; the emailed comments were also coded and contributed to the theme development. An independent researcher also reviewed the transcription document data to formulate codes and themes; this process took place to improve and ensure the thematic analysis accuracy. Deviations in the theme development were discussed and collaboration took place between the researchers.

Identified Themes. The objective of the thematic analysis was to explore the concepts and themes in relation to the weight-loss intervention. The thematic analysis (Braun & Clarke, 2006) found central themes within and across the two focus group sessions. These were “user friendly intervention,” “film techniques,” “content simplicity versus complexity,” “intervention deviations,” “motivation and encouragement,” “visual displays and examples,” “kilojoules versus calories

distinction," "health emphasis," and "expanding and clarifying information." Each of these themes is discussed below. The subsequent section covers how each of these themes assisted with the redevelopment of the intervention.

User friendly intervention. This theme addressed the need to modify the intervention to provide simplicity, user friendliness, and to be a personal experience. As discussed below, this theme included the identified need for an intervention name and intervention delivery via the Qualtrics™ program.

Intervention name. The original intervention referred to the program as the "weight-loss intervention;" however the title appeared to be too general. The health professional participants discussed the need for a distinct intervention name which could then be contextualised within the video presentation.

Intervention delivery via Qualtrics™ *and personalisation.* Participants within the health professionals focus group session raised concerns that the intervention requires a level of technical competence. The term "URL link" was used to direct participants to complete an online questionnaire. Also, participants were asked to "pause the video" to complete the activities on the paper activity handout. Some focus group participants believed that the instructions and method of intervention delivery required technical competence. Based on this feedback, the researcher presented the idea of using the Qualtrics™ program (an internet-based online survey program) to incorporate all aspects of the intervention including the video presentation, online questionnaires, and activity handout information on the "one screen."

Focus group participants agreed that the use of Qualtrics™ will allow the intervention delivery to be user friendly due to removing the need for technical competence and delivering the whole intervention via the "one screen." Participants

would not be required to 'look up information' such as the goals they previously listed and their calorie allowance amount, with the relevant information fed back to them via the Qualtrics™ program. In addition, the intervention viewers could check their goals through having a checklist option on Qualtrics™, as opposed to reading the checklist via the slides displayed in the video. It was believed that through the use of Qualtrics™ the participants may experience the intervention as more personal.

Film techniques. This theme related to the issues linked to the filming techniques, including scene settings, camera, and the presenter's presentation style within the video. These issues are described below.

Scene settings. The filming took place at three locations. The primary location included a clinic room that showed a grey wall in the background. The second location, when discussing exercise and physical activity, included a park. The third location, when discussing dietary energy intake, included a kitchen.

Based on focus group participant feedback, the scene settings appeared to influence the "tone" that the intervention created. Participants reported that the park and kitchen setting was "nice" and "good." However, participants in both focus group sessions reported dislike towards the primary location's grey wall background. For example, the grey wall was described as "kind of depressing" and "did nothing to help create inspiration." Another participant suggested that the image created was "looking professional and authoritative" and questioned whether this was the aim or whether a "friendly and 'were in this together' " tone was sought. A suggestion was made that sitting in a lounge room may meet this need. Another participant suggested that a background with a white wall may be more appropriate.

Camera and presenter's presence. Comments in relation to the presenter's presence included that the clothing worn was appropriate; however one focus group

participant suggested that a brighter colour could be worn when or if standing in front of the grey wall background. Also suggested was that direct eye contact with the camera was needed. One participant stated that the presenter's distance from the camera, and lighting was appropriate. Voice clarity and pace was reported to be suitable, however the presenter's tone required the need to express "some more emotion" such as "the 'you can do this'…to motivate your client." Another focus group participant reported that the presenter could relate to the audience through addressing the intervention viewer watching the video and using people's names when providing examples, such as "imagine John was doing this."

Content simplicity versus complexity. This theme was defined by the balance between content simplicity and providing minimal information to meet the basic requirements, versus content complexity and providing too much information. The need for this balance was apparent in various areas as outlined below. Some of the differences in opinions between the health professionals and community focus group participants, as well as participants within the same focus group, are likely to be due to different levels of education, training, and common knowledge related to healthy eating; however no conclusive interpretation can be drawn from the diversity of the opinions expressed. The areas identified within this theme include: terms related to risk factors, use of the Calorie King book, goal setting activity, calorie comparisons, content balance, and intervention length.

Terms related to risk factors. Some participants in the health professionals focus group suggested that discussing the obesity-related risk factors and the "psychological" and "physiological" risk factors "might be too much of a complex concept to understand," however no concerns were raised within the community focus group regarding this topic. Participants in the community focus group reported

that the information about the obesity-related risk factors was interesting, which emphasised that the information was understood and deemed as important: “some things I knew, and some things I didn’t know I found interesting.” Within the health professionals focus group, the consensus was that the risk factors should still be discussed however in simple terms.

Use of the Calorie King book. Participants within the health professionals focus group stated that the explanation of the use of the content and index pages of the Calorie King book to find calorie information content for specific food items was unnecessary and too basic. However, participants in the community focus group suggested that this information was relevant “I just think it makes it really simple, and it’s kind of encouraging how obvious it [the calorie content information] stated and you don’t have to work too hard to get the answer.” Participants within the health professionals focus group appeared to have enhanced training in the area of health behaviour and thus some areas that they perceived as “too basic” appeared to be relevant for participants within the community focus group. For example, a participant in the community focus group expressed confusion about the use of nutritional labels to identify the serving size information. The other participants within the community focus group provided correct information to the query which suggests that the other participants did have this common knowledge. The situation emphasised the importance of ensuring the intervention content needed to be basic enough for the intervention viewers to understand, as the weight-loss intervention is designed to cater for individuals from a diverse range of backgrounds.

Goal setting activity. The need to ensure the simplicity of the goal setting section was mentioned. One focus group participant suggested that a table could be used to generate goals or inform goal setting. Another participant suggested that the

use of SMART (specific, measurable, attainable, realistic, and timely) goals could assist participants in recording and achieving their goals.

Calorie comparisons. The importance of having a balance between simplicity and complexity was also apparent among the health professionals focus group participants when discussing calorie comparisons. That is, the extent of information is optimal to facilitate calculations of differences in calorie content between two food products. One focus group participant suggested "make it a bit simpler and not explain [the] amount of calories, just say 'flavoured tuna is double the amount of calories as non-flavoured' and not even…[provide the calorie amount of the two products] information." However; an important concern was raised by a focus group participant that "if people are going to be doing it [calorie counting] themselves, they will maybe face those kinds of calculations." The discussion followed with a middle ground sought; that is, the maximum information could be provided in a simplistic form. For example, "the skim milk cappuccino has 70 calories, while full fat cappuccino has 125, so that's a difference of you know [x amount]."

Content balance. Participants from both focus groups reported that the intervention information was comprehensive and interesting, and such comments were especially made when the content was shown in a simplistic form. Most focus group participants reported that although the intervention content was clear and easy to understand, it was "content heavy." Some participants suggested that some content be reduced, however another participant stated the challenge involved; "the other thing is that you probably need to put into perspective [that] this is the only information they will get. It's not like they will get any other information during the course of the 12 weeks, so it is very non–intensive, so you need to make sure that lots of information comes across, and they understand it. We are trying to make it as

simple as possible, but there's a fine line between too simple, not giving enough information, to you know, giving enough so that they remember. Sometimes repetition when they don't get it [the] first time helps, because they are listening to it." Participants in both focus groups suggested that due to the necessity of the intervention remaining "content heavy," to provide sufficient weight-loss information, the need for a handout containing program summary information was identified to potentially assist the intervention viewer with their ability to retain the information.

Intervention length. The intervention length was a topic of discussion that conveyed various opinions among the focus group participants. The researcher informed the participants that the total intervention time would be between 60 to 90 minutes, with the video presentation lasting 40 minutes and the intervention viewers required to complete various activities and questions. Some focus group participants stated that the intervention time was appropriate, with the opinion that this session *is* the intervention. Other focus group participants expressed concern that if the intervention was too long then the intervention viewers may become restless and lose interest. Most participants agreed that a 60 minute intervention duration is acceptable. Also, the possibility of providing the intervention viewer with a break was suggested. The health professionals focus group identified two minor areas deemed as unnecessary, and that the intervention could remove the information on "basal metabolic rate" and the reading of the dietary guidelines for the intervention viewer when the guidelines are displayed on the screen. This was considered to be a critical point given the potential of the intervention viewers losing interest in the program, which may affect engagement in the intervention components from the HAPA.

Intervention deviations. The weight-loss intervention suggested that the participants/viewers follow physical activity and dietary energy intake guidelines. The guidelines were described as being clear indicating that the focus group participants understood the behaviour changes required to reach the weight-loss goal. However, the theme of intervention deviations was identified. Specifically, the need for further information to address the implication of when the intervention viewers deviate from the intervention, and the intervention viewer's potential inability to engage with the intervention guidelines; these issues are described below.

Implications of deviating from the intervention guidelines. Participants from both focus groups questioned the implications of deviating from the intervention guidelines. This includes when the intervention viewer exceeds their calorie allowance or does not exercise as required. Focus group participants expressed concerns that due to the rigidity of the intervention guidelines, the intervention viewer may feel a sense of failure, hopelessness, or guilt if the guidelines are not met. The researcher proposed that the intervention viewers will be directed to follow the guidelines to assist them in reaching the desired weight-loss outcome; however, the researcher also proposed that the intervention viewers can be provided with information on relapse prevention including "each day you reset those goals and try your best to achieve them." The focus group participants believed this approach was suitable to manage the issue. The question of whether the intervention viewer will need to "make up" for not exercising and catch up on subsequent days was raised by focus group participants; this appeared to be seen as inappropriate as it may lead to the intervention viewers feeling a sense of failure. Instead, a consensus was that a suggestion could be made to direct the intervention viewers to engage in a minimum of 30 minutes of daily exercise.

Potential inabilities to follow the guidelines. The topic of providing an alternative for intervention viewers who may struggle with meeting the guidelines was suggested within the health professionals focus group. For example, one focus group participant raised an important concern stating "what are you supposed to do if let's say they can't actually do 30 minutes when you start?" The need to introduce the concept of shaping to address this concern was discussed by the health professionals focus group participants. For example, one participant stated it may be helpful to suggest "if you can't do 30 minutes, then start with 10 ten [minutes], or do three times 10 minute blocks throughout the day, doesn't have to all be at once." In addition, the focus group participants stated the necessity to redirect the intervention viewer to contact their general practitioner if they have any concerns or difficulties in relation to physical activity. A focus group participant questioned the guideline that suggests the need for 30 minutes of daily exercise and the implications of "if there are circumstances if they miss a day or two of exercise." This suggested the need to ensure the intervention viewers are provided with information on deviations from the guidelines, however also highlighted (although not explicitly expressed) was that the need for daily exercise may be regarded as inflexible or unrealistic. This provided interesting insight as a major topic throughout the focus group sessions was the importance of ensuring the intervention viewers do not feel a sense of failure, hopelessness, and to provide the viewer with motivation and encouragement.

Motivation and encouragement. The theme of providing the intervention viewer with motivation and encouragement was identified. There was consensus that the intervention needed to motivate and encourage participants to (1) install interest in the intervention, and to (2) implement the required weight-loss behaviours. Elements of this theme were apparent within both of the focus group sessions. It was

important to note that the focus group participants may not have been interested in weight-loss in the first place, thus explaining, or contributing to, their lack of motivation after viewing the intervention. The intervention viewers that engage in the weight-loss intervention are those who would have already made a decision to lose weight, and thus may display higher levels of motivation prior to watching the video intervention. The difference between the focus group participants and intervention viewers' potential motivation levels is an important distinction to note. Despite these potential differences providing the intervention viewer with motivation and encouragement is an important topic to examine as it may influence the viewers' engagement in the weight-loss intervention; these issues are discussed below.

Motivation to instil interest in the intervention. Among the community focus group participants, the intervention was believed to have instilled an overall sense of interest (e.g., use of the five sensory elements within the mental imagery intervention components) and provide new information (e.g., understanding of how to interpret nutritional labels). However; the intervention did not appear to motivate the focus group participants. Community focus group participants suggested that the intervention viewers could be motivated to complete the activities within the video intervention, through expanding on the reasons behind the need to complete the intervention activities, and the benefits that the activities will provide to the intervention viewer. This includes reminding the intervention viewer of their goals and how the activities can assist them. In addition, psycho-education about how being obese can have an impact on their children was believed to be an appropriate motivating factor.

The idea behind the combination of psychology linked to weight-loss appeared to be of interest among the community focus group participants. However, the need to motivate the intervention viewers and expand on how the current intervention differs to other weight-loss interventions was not explicitly expressed or apparent. The community focus group participants believed that by informing the intervention viewer that the techniques are evidence-based, it may increase the viewer's motivation.

Motivation to implement the required weight-loss behaviour. Participants from both focus group sessions discussed the need to motivate the intervention viewer to implement the intervention guidelines. The need to explicitly acknowledge that weight-loss can be difficult and normalise this difficulty was expressed. In addition, the need to normalise that it is common to feel unmotivated at times was discussed; the notion that it is important to remind ourselves of our goals was evident. Focus group participants suggested the need to normalise that weight-loss can be difficult in order to assist with improving the intervention viewers' motivation; "I think it [the weight-loss intervention] is really, like for me personally I found it really clear, and I think that's a very nice way of breaking it down. But I'm still thinking that's way too hard."

Focus group participants also expressed the need to acknowledge feelings of guilt and hopelessness relating to relapse, and feeling discouraged due to not being able to lose weight. Focus group participants also reported the need to provide encouragement by informing the intervention viewer that the "small choices" made can lead to a "big difference" and contribute to weight-loss. In addition, to provide encouragement and maintain motivation, it was suggested that the intervention

viewers are informed that calorie counting becomes easier with time. Relating how calorie counting can easily be applied to the intervention viewer's life was also believed to be important to assist with improving motivation levels. A focus group participant relayed the idea of reminding intervention viewers that calculating calorie content only needs to occur when having a meal for the first time.

Visual displays and examples. This theme was defined by the need for an increased use of visual displays and examples within the intervention. The use of visual displays was frequently discussed in both focus group sessions. It was suggested that the use of visual demonstrations could assist intervention viewers with retaining information, aiding understanding, and improving motivation. The theme of visual displays appeared to be a method in itself, which could be applied to assist with some of the other outlined themes; this is discussed below.

Use of visual displays and examples. When explaining the information within the nutritional labels, such as the calorie amount, the need to use a curser or circle the discussed information was deemed necessary to assist the intervention viewer to locate the information displayed on the screen. It was suggested that visual display in this area could assist with ensuring the content is delivered in a 'simple' method. During the example of how to mentally imagine one's goals, a text based slide was used and the slide information was read. A focus group participant suggested that a video of an individual conducting their goals can be displayed, whilst the steps conducted are verbalised. Use of a visual display in this area was believed to assist with improving the intervention viewer's engagement, retaining information, aiding understanding, and delivering the content in a 'simple' method. Visual displays were also believed to be useful to assist in improving the intervention viewer's motivation.

For example, participants within the community focus group suggested that the use of "before and after" weight-loss pictures, would be an appropriate mean to visually display the intervention viewer with the results of weight-loss. In addition, it was suggested that a video clip of an individual relapsing could be incorporated to normalise deviations from the guidelines (directing intervention viewers on how to return to the intervention guidelines).

Focus group participants believed that increased use of visual displays are a useful method to demonstrate information. Participants enjoyed the presenter showing various food items during the video such as cans of tuna, and mentioned that increasing the visual displays, such as providing a lunch example would be beneficial. Focus group participants believed that visual displays could be used to demonstrate to the intervention viewers that healthy food "still looks tasty" which may then increase the intervention viewer's motivation to engage with the intervention's recommended guidelines.

The community focus group participants reported that in order to assist the intervention viewers to meet the dietary energy intake guidelines, a visualisation tool could be used, for example, when eating out at restaurants. For example, the tool could display the information in an easy to understand visual form such as, "x number of grams of cheese…[is] the size of a match box." The researcher informed the focus group participants that during the orientation session the intervention viewers will be provided with a visual tool which allows them to compare food amounts to assist in estimating food consumption. However; focus group participants suggested that this visual tool information should be repeated in the video intervention to assist the intervention viewers in their ability to meet the guidelines.

Kilojoules versus calories distinction. This theme was defined by focus group feedback discussions related to the use of the term kilojoules or calories when discussing calorie counting. Preference for the use of either the term kilojoules or calories was an area of discussion within the health professionals focus group session. Within the video intervention, the presenter introduced the terms kilojoules and calories, and informed the intervention viewer of the difference between the two unit types. The presenter also stated that when calorie counting, the intervention viewer can use their preferred term although subsequent explanations would use the term calories. Although the focus group participants recognised that the Australian standard is kilojoules, the majority of participants preferred the term calories. This topic was not discussed among the community focus group participants, although one participant stated that the explanation of how to convert between calories and kilojoules was "very simple."

Health emphasis. This theme was defined by the need to expand on health and healthy eating within the intervention. The need for an increased emphasis on health was raised only among the community focus group participants. Focus group participants stated there is a need to inform the intervention viewer that a balance between calorie consumption and healthy eating is required. That is, weight-loss can be achieved through calorie counting, however not all low-calorie drinks are the healthiest. For example, orange juice is deemed to be better for an individual's health, however will contain more calories compared to low-calorie diet soft drinks that might be considered less healthy from the perspective of its nutritive value. Focus group participants agreed that expanding on the Australian dietary guidelines information is important. Other dietary energy intake information such as suggesting

that the intervention viewer consumes a large breakfast and has a light dinner was also discussed. In addition, emphasis on how engaging in the intervention guidelines may reduce obesity-related risk factors even in the occurrence of no weight change was deemed necessary.

Expanding and clarifying information. This theme related to the content areas that require modification including the need for clarifying and expanding on information. These areas are discussed below.

Clarifying information. Suggestions to clarify some of the intervention content information included rewording phrases and providing definitions. An example of the need to reword a certain phrase to provide clarity included the sentence stating "you don't use up all your calories and then run out of them." This phrase was referred to as "kind of tricky." Also, the need to define certain terms to clarify the intervention viewer's understanding was deemed necessary. This included clarifying and defining the term "plenty of water" when discussing the Australian dietary guideline requirements.

Expanding on information. The need to expand on concepts through providing a more detailed explanation or further examples to illustrate the information was apparent. The need to provide a detailed explanation within the physical activity section was highlighted which included providing information on how the intervention viewer will recognise that their heart rate is high, and signs that the viewer has reached their physical activity limits. Also identified was the need for detailed explanations within the dietary intake section, such as providing more information on nutritional labels (e.g., serving size, and the meaning of all the labels

for each of the columns). Providing an explanation of the science and psychology behind the intervention activities and how engaging in the activities would assist the intervention viewer was also highlighted. Also mentioned was that the calorie discrepancies between the Calorie King book and nutrition labels needed to be explained. Providing intervention viewers with further information on the minimum to maximum calorie allowance amount, and psycho-education regarding changes in calorie requirements with weight-loss was also believed to be beneficial. Expanding on concepts by providing further examples was suggested by focus group participants within the areas of goal setting, meal plan ideas, and how to read nutritional labels. Also suggested was the need to change the activity that demonstrated a physical activity mental imagery example; this included providing a different environmental cue to associate with physical activity, and the need to evoke positive feeling related to the activity.

Summary. The draft version of the video intervention was developed and recorded for pilot purposes. Two focus group sessions were conducted to explore the content and themes of the weight-loss intervention. Thematic analysis of the focus group transcripts (Braun & Clarke, 2006) revealed central themes across the two focus group sessions. The implication of these findings and how they led to the redevelopment of the weight-loss intervention program is discussed in stage three.

Stage Three: Intervention Amendments and Developments

The third stage of the intervention development and pilot consisted of redeveloping the weight-loss intervention based on the thematic analysis data, and re-recording the intervention video footage to a ‘professional’ level. The outlined

results from the thematic analysis highlighted some crucial findings to assist with improving the weight-loss intervention effectiveness. The intervention program was amended based on the focus group feedback contained within the area of each of the nine identified themes. The changes were then approved after undertaking a process of review, feedback, and editing by two expert academic reviewers and two members in the community. The two academic reviewers have backgrounds in the health profession with postgraduate degrees in the area of psychology and public health respectively. The two members of the community did not have a background in the health profession; one holds a postgraduate degree in business administration, and the other holds a bachelor of screen arts. Finally, based on the identified themes, amendments were made (from the draft version of the intervention) to modify and create the final intervention version (*see* Appendix G).

Intervention amendments within each identified theme. Based on the nine identified themes and feedback received, the researcher made changes to the final version of the intervention. The major amendments and decisions made in accordance with each of the identified themes are outlined below.

User friendly intervention. This theme to modify the intervention to provide simplicity, user friendliness, and create a personal experience was met by implementing the following changes.

Intervention name. The intervention was titled the "HEALTHI program." The title HEALTHI is an acronym for Healthy Eating and Active LifesTyle Health Intervention. The intervention viewer was introduced to the HEALTHI program. Following the intervention introduction, the term HEALTHI program was contextualised within the video program presentation.

Intervention delivery via Qualtrics™ and personalisation. All HEALTHI program components were delivered through the Qualtrics™ program as focus group participants believed this would provide simplicity for the intervention viewer, with all information made available on the "one screen." Qualtrics™ also allowed for the intervention viewer's personal information (including their name, calorie or kilojoule allowance amount, and personal goals) to be fed back to them when relevant to personalise the intervention experience.

Calorie King journal. To provide simplicity and increase user friendliness, the researcher decided that at the initial HEALTHI program clinic appointment, the intervention viewer will be provided with the option to receive the Calorie King journal to record their calorie or kilojoule intake and exercise (which is in addition to the Calorie King book).

Film techniques. This theme related to the film technique elements, including scene settings, camera and the presenter's presentation style within the video. The following changes were made based on the focus group feedback under the following headings.

Scene settings. The use of two of the previous filming locations (kitchen and park) were deemed suitable. However; the grey wall background was not used as focus group participants indicated dislike for the background colour. Instead a variety of setting backgrounds deemed as appropriate were used and included a white wall, wooden frame pattern, clinic room in front of a computer, and other backgrounds. The presenter attempted to create a "friendly" and "teamwork" tone to provide the intervention viewers with encouragement.

Camera and presenter's presence. The presenter dressed in smart casual clothing (as opposed to the previous professional look wearing all black clothing) to

create a “friendly” and “fun” tone. The need to maintain eye contact with the camera was identified during the focus group sessions and therefore a teleprompter was used during the final filming of the intervention. The presenter increased the expression of emotion to motivate the intervention viewer as this need was identified during the focus group sessions. To address the need to relate to the intervention viewers, as suggested by the focus group participants, when sharing examples, the presenter used random names and the term “you” directed at the intervention viewer.

Content simplicity versus complexity. The need for a balance between content simplicity and providing minimal information to meet basic requirements, versus content complexity and providing too much information was an identified theme. Changes related to this theme were made based on the focus group feedback.

Terms related to risk factors. Information on the obesity-related risk factors remained, however was discussed using more simple terms to provide the information but eliminating complexity. For example, the terms “psychological” and “physiological” risk factors were not used.

Use of the Calorie King book. To provide simplicity when providing examples of the steps involved in calorie counting, circles and arrows were used on the screen to highlight the words or values of numbers being discussed; for example, when explaining the use of nutritional labels to identify the serving size information. This was done to provide a balance between simplicity and complexity as the health professionals focus group participants believed the content was too basic, while the community focus group participants believed the information was relevant. In addition, one participant in the community focus group reported confusion in relation to the explanation on the use of nutritional labels to identify the serving size information, stating “what about the serving sizes, are they basically noted down

there. For example, here it says serving size is four biscuits, is it same for every type of biscuit? Or you know is every serving actually four biscuits? What if biscuits are bigger or smaller?" The situation emphasised the importance of ensuring the intervention content was basic enough for the intervention viewers to understand as the HEALTHI program was designed to cater for individuals from a diverse range of backgrounds. In addition, further information on nutritional labels and identifying the serving sizes was provided.

Goal setting activity. To simplify the goal setting section, the use of SMART (specific, measurable, attainable, realistic, and timely) goals (Boyes, 2001) were introduced and discussed as per focus group participant recommendations. This was believed to potentially improve the intervention viewer's motivation and assist in their ability to create, record, achieve, and evaluate their goals.

Calorie comparisons. Calorie comparisons were retained in order to provide information to calculate the difference in calorie content between two products. An amendment based on focus group feedback, was that the difference in the calorie amount was also stated. Terms such as "double the amount" were used more frequently. For example, "…the tuna in spring water is… 69 calories, whereas flavoured tuna cans vary in calorie content and can even have double the amount, such as the lemon and cracked pepper flavour…which is 132 calories. So I could have one can of lemon and cracked pepper tuna, or two cans of non-flavoured tuna for the same amount of calories." Another example is "…drinking a skim milk cappuccino has 70 calories, while a full fat cappuccino with whole milk is almost double the amount of calories, containing 125 calories."

Content balance. To provide a balance between simplicity and complexity, and the need to provide sufficient weight-loss information, the use of a program

summary handout was identified by the focus group participants. A handout was suggested to assist the intervention viewers with their ability to retain the program information. After viewing the HEALTHI program videos, the intervention viewer was emailed a handout providing essential program information that was containing within the video presentation. In addition, it was decided that for easy reference the intervention viewer would be provided with their personal answers to various activities and questions such as their minimum and maximum calorie or kilojoule allowance amount and goals; this information was emailed along with the HEALTHI program handout.

Intervention length. Mixed opinions on the intervention duration were found among focus group participants. Concerns to ensure that the intervention was not too long were expressed, however many participants indicated the need to provide more information and examples. Information deemed as unnecessary by focus group participants was omitted including information on "basal metabolic rate." Also, the Australian dietary guidelines were displayed for the intervention viewer in the form of a slide to read on their own, with the presenter no longer reading the guidelines on their behalf. Also, at the initial appointment a copy of the Australian Dietary and Physical Activity Guidelines was provided to the intervention viewer in pamphlet form. With the inclusion of the examples and information requested by the focus group participants, the intervention length varied from 90 to 120 minutes for the psycho-education weight-loss condition, and between 120 to 210 minutes for the intervention conditions. This time included the videos, completion of the activities and questionnaires, and time for breaks. To account for the intervention length, the researcher informed the intervention viewers that they could have a break when needed and within the HEALTHI program videos, the intervention viewers were

prompted to take breaks at certain time points. Intervention viewers within the psycho-education weight-loss condition were prompted to break at one time point (as the program was shorter in duration). Intervention viewers within the intervention conditions were prompted to break at two time points. The HEALTHI program duration time exceeded the ideal time frame, however it was deemed necessary to compromise a short intervention time to ensure the intervention viewer was provided with adequate information to successfully follow the program.

Intervention deviations. Changes made in relation to this theme of providing information to the intervention viewers on the implications of deviating from the intervention guidelines and potential inability to follow the guidelines is discussed.

Implications of deviating from the intervention guidelines. The intervention viewer was encouraged to follow the dietary intake and physical activity guidelines with emphasises on how the behaviour changes can assist them with their weight-loss goal. However; the intervention viewer was provided with information on relapse prevention including "…if you go over your calorie allowance on a certain day, that is okay. Try your best to continue the day making healthy choices…" A story about a man named Sam was also shared which outlined how Sam had exceeded his maximum calorie allowance and wanted to give up, however Sam had a change of thought and decided to continue with the HEALTHI program guidelines. In addition, the intervention viewer was encouraged to "engage in a minimum of 30 minutes of planned daily exercise. If you feel like doing more exercise, then you may." The intervention viewer was also provided with information on how to achieve their goals and relapse prevention.

Potential inabilities to follow the guidelines. The need to provide an alternative for intervention viewers who may struggle to achieve the recommended

30 minutes of daily exercise as per the physical activity guidelines was highlighted in the health professionals focus group. As suggested by a focus group participant the presenter introduced the concept of shaping. For example, the intervention viewer was told that "although it is better if you try to do the 30 minutes of exercise in the one setting, if you are unable to then there are a few options to help you to get there." The intervention viewer was then told a story about three people who either slowly increased their fitness levels or used shaping techniques to assist them to get to the goal of completing their 30 minutes of planned exercise using a considerable activity level (not light intensity exercise). Related to the ideas presented in this theme, the researcher decided there was a need for the presenter to redirect the intervention viewer to contact their doctor or a professional exercise specialist if they had any concerns or difficulties in relation to physical activity. The intervention viewer was also provided with information on the signs that may appear when they exceed their physical activity abilities, such as being short of breath or experiencing pain.

Motivation and encouragement. Changes related to the theme for the need of the intervention to motivate and encourage intervention viewers is discussed below.

Motivation to instil interest in the intervention. When introducing the intervention via the video presentation, the presenter asked the intervention viewer to think about the reasons they would like to lose weight; this was done in an attempt to increase the intervention viewer's motivation and engagement in the intervention. Some examples are also provided such as; "Is it to improve your health? Or is it to feel more comfortable with your body? Do you want to improve your physical appearance? Or become a good role model for your children?" The weight-loss reasons are fed back to the intervention viewer during the HEALTHI program, and

these weight-loss reasons are an example of the activity information that is emailed to the intervention viewer along with the HEALTHI program handout.

The intervention viewers were indirectly provided with information on how the current intervention differs to others weight-loss interventions through emphasis on the use of evidence-based psychological techniques to target health-behaviour changes as per suggestions from the focus group participants to assist with increasing motivation levels. For example, the intervention viewer was told that "research has shown that by doing these activities it will help you to complete the behaviours related to reaching your goals. For example, it may assist you in remembering your plans and good intentions, and increase your motivation and confidence in your ability to change your behaviour."

The presenter attempted to motivate the intervention viewers to engage in the intervention activities through briefly expanding on the reasons behind completing the intervention activities and the benefits that the activities would provide to the intervention viewer as per focus group suggestions. That is, reminding the intervention viewer of their goals and how the activities can assist. For example, "this task is believed to assist you in increasing your confidence to carry out your goals and this is why it is important for us to take the time to do this." The intervention viewer is also asked to read the "weight-loss reasons that you listed previously" in an attempt to motivate the intervention viewer towards their goals.

Motivation to implement the required weight-loss behaviour. The presenter explicitly acknowledged that weight-loss can be difficult and normalised this difficulty as was deemed necessary by the focus group participants. It was believed that normalising weight-loss difficulty may motivate the intervention viewer to implement the intervention guidelines. As per focus group suggestions, lack of

motivation as a potential problem was acknowledged within the HEALTHI program. The presenter normalised the concept that it is common to feel unmotivated at times and that the aim of the HEALTHI program is to assist the intervention viewers to reach their goals. For example, “whatever the reason for you wanting to lose weight, I want to help you to get there! If you have tried to lose weight in the past, you would know that sometimes it isn’t easy and we do not always feel motivated to do the things that will help us lose weight. This is totally normal, and this is why the HEALTHI program tries to keep weight-loss simple, by introducing you to two guidelines that you will be asked to meet one day at a time.” In addition, the presenter stated that each small decision made may contribute to a larger result. For example, “remember it is the small choices you make each day that can lead to a big difference in helping you to lose weight.”

As per the focus group recommendations, the presenter also acknowledged feelings of guilt and hopelessness that could arise in intervention viewers that relate to relapse, and feelings of discouragement due to not being able to lose weight. For example, “feeling discouraged or guilty cannot reverse the bad days you have. Instead learning from your past mistakes and moving forward is the best way to achieve your weight-loss goal. Each day is a new beginning.” Another example is, “sometimes even when the numbers on the scale are not moving it does not mean that you have not contributed positively to your goals. I know it can feel frustrating when no weight change has occurred, but remember if you are following the guidelines then there can be another explanation.” The presenter then continued to explain some possible reasons behind no weight change such as increased muscle mass or water mass. In addition, the presenter discussed how even in the abstinence

of weight change, the intervention viewer could be reducing their obesity-related risk factors such as decreasing blood pressure and cholesterol levels.

To provide encouragement and maintain motivation, the intervention viewer was provided with reassurance that calorie counting becomes easier with time as mention of this was seen as important by focus group participants. For example, "thinking about calorie counting can sometimes feel like it will be a bit of work. Calorie counting is actually quite simple once you have learnt how, and it will require less effort as time goes on. Also, the good news is you won't *always* have to calorie count. For example, you probably have a favourite breakfast, and once you have worked out the calorie amount the first time, then the next time you have that breakfast, you don't have to calculate it!" In addition, as suggested in the focus group sessions, the presenter related how calorie counting could easily be applied to one's life in an attempt to improve the intervention viewer's motivation. Also discussed is how "eating out can *still* be easy."

Based on the identified need to increase motivation, the researcher decided that it would be appropriate to incorporate an additional mental imagery activity task within the HEALTHI program (intervention conditions only) which focuses on outcome mental imagery. The previous version of the intervention solely focused on the use of process mental imagery; that is, imagery related to the steps needed to achieve the desired outcome, which according to Pham and Taylor (1999) is mainly a cognitive planning strategy (Hagger et al., 2011). The researcher believed that motivation levels may be increased by incorporating an activity that encourages outcome mental imagery. Outcome mental imagery relates to the experience of goal achievement and success, and therefore is a motivational approach for improving goal achievement.

Visual displays and examples. The need to increase the use of visual displays and examples was an identified theme. Based on the focus group feedback the changes related to this theme are discussed below.

Use of visual displays and examples. When displaying a nutritional label and discussing the calorie amount, the calorie information was circled to assist the intervention viewer to locate the discussed information. Also, when providing examples of how to mentally imagine one's goals, a video of a person conducting the goals was displayed, whilst the steps conducted were verbalised. This was done as per focus group feedback. The suggestion by a focus group participant to visually demonstrate to the intervention viewer, the outcome of weight-loss with "before and after" weight-loss pictures were not used, as the photos cannot be specific to individuals whom engaged in the HEALTHI program.

A focus group participant's suggestion to include a video clip of an individual relapsing to normalise deviations from the guidelines, was not incorporated as it was not specific to the HEALTHI program. However, to address this issue, the HEALTHI program included an example of an individual named Sam who deviated from the intervention guidelines and relapse prevention was verbally discussed (directing the intervention viewer on how to return to the intervention guidelines following a relapse).

Visual displays of healthy food that 'look tasty' were shown in the HEALTHI program handout and within the program video presentations. This was aimed to increase the intervention viewer's motivation to engage with the intervention's recommended guidelines. This was executed based on focus group participant

feedback. The presenter also encouraged the intervention viewer to use a visualisation tool to allow them to compare food amounts to assist with estimating food consumption. The intervention viewers were taught how to use this visual tool during the orientation session, and as suggested by focus group participants, the intervention viewer was again briefly reminded of the tool during the HEALTHI program video presentation. The use of this tool is believed to assist the intervention viewer with following the dietary energy intake guidelines especially when dinning out. For example, “the palm of your hand is equivalent to approximately 100 grams.” This was also done in an attempt to make the guidelines as simple as possible to follow which may encourage the intervention viewer to persist with meeting the HEALTHI program guidelines.

Kilojoules versus calories distinction. This theme related to the use of the terms kilojoules and calories. Due to varied preferences from the focus group participants for either term, it was decided that the intervention viewer is able to use either term at their discretion as per the original intervention video presentation. The terms kilojoules and calories were introduced, and the intervention viewer was informed of the difference between the two unit types, and unit conversion information. The presenter expressed that when calorie counting, the intervention viewer can use their preferred term, however that subsequent explanations within the video presentations will use the term calories. The intervention viewers were provided with their energy intake recommendation amount in both the terms calories and kilojoules to cater for individual preferences. The dietary energy intake guideline also incorporated both the terms “calories or kilojoules” in order to relate to all intervention viewers regardless of their preference.

Health emphasis. Changes made related to this theme to expand on health and healthy eating within the intervention are discussed. The presenter provided the intervention viewer with information about the balance between calorie consumption and healthy eating. That is, weight-loss can be achieved through calorie counting, however not all low-calorie drinks or foods are healthier. For example, "orange juice is deemed to be better for your health, although it will contain more calories compared to the unhealthier low-calorie drinks such as diet coke." More detailed information on the Australian dietary guidelines was also discussed to provide further information on healthy eating. As per focus group participant recommendations, during the video presentation, the intervention viewer was provided with more information on health eating and meal ideas. Also, the HEALTHI program handout provided to the intervention viewer contained a list of some of these healthy meal ideas.

Focus group participants discussed the benefits of consuming a large breakfast and lighter dinner. Based on this feedback the following changes were made. The intervention viewer was advised that "it may help if you eat breakfast and ensure this is a meal that keeps you feeling satisfied. For me, breakfast is my largest meal. It helps me feel full for longer, so I reduce the amount of snacks that I have throughout my day." The intervention viewer was also advised that "…having a lighter dinner may be helpful, as the food that you eat just before you sleep cannot be expended."

Engagement in physical activity and healthy eating may reduce obesity-related risk factors in the absence of weight-loss. This information was presented in the video intervention. The presenter emphasised on how engaging in the

intervention guidelines may reduce obesity-related risk factors even in the occurrence of no weight change. For example, "…even with no weight change…you may be contributing to a healthier you by following the guidelines! You could be reducing the obesity-related risk factors. For example, you may be helping to decrease your blood pressure and cholesterol level which is leading to better health!"

Expanding and clarifying information. Changes made related to this theme of expanding and clarifying information are discussed.

Clarifying information: The wording of the intervention was modified to improve understanding as per focus group participant feedback. For example, the phrase "plenty of water" was defined. That is, the presenter stated "the guidelines recommend that each day you drink plenty of water... aim for at least 2 litres per day, which is about 8 glasses." The presenter also provided detailed explanation for some terms, including information on how the intervention viewer will know whether they are engaging in light, moderate, or vigorous intensity exercise. Also discussed were the signs that indicate to the intervention viewer that they have reached their physical activity limits and the action required. For example, "…overexerting yourself…some signs to look out for that may indicate you are pushing yourself too hard, include being short of breath or experiencing pain. If this occurs then slow down, build your intensity level gradually, and if necessary seek some advice from a health professional."

Expanding on information. More information on nutritional labels (e.g., serving size, and the meaning of the label columns) was also made available. This information was discussed verbally and shown visually in an attempt to provide the

intervention viewer with a better understanding. This change was made based on feedback from focus group participants to provide more examples and the appeal of visual aids. As highlighted earlier, the presenter provided an explanation of the reasons behind the intervention activities and how engaging in the activities would assist the intervention viewer. For example, “it is important that we do this activity as it is believed to assist in increasing your confidence in being able to carry out your goals.”

Focus group participants mentioned that the calorie discrepancies between the Calorie King book and nutrition labels needed to be explained. Therefore, during the video, the presenter explained that calorie discrepancies may sometimes occur and the reason behind these discrepancies. In addition, information on how to manage discrepancies and the information to use (choosing nutritional labels over the Calorie King book when faced with a discrepancy) was covered. Focus group participants stated that providing the intervention viewer with further information on their minimum to maximum calorie allowance amount, and psycho-education regarding changes in calorie requirements with weight-loss, would be beneficial. Therefore, prior to viewing, and during the intervention video, the intervention viewer was provided with their minimum to maximum calorie and kilojoule energy intake allowance amount. In addition, the intervention viewer was provided with some psycho-education regarding changes in calorie requirements with weight-loss. Also, at follow-up clinic appointments, the intervention viewer was provided with an updated calculation of their energy intake allowance amount based on their body weight at the time.

Additional examples were provided to the intervention viewers in the areas of goal setting, meal plan ideas, how to read nutritional labels, and mental imagery. A modified example that incorporated mental imagery and exercise goals was used. The modified example attempted to create or evoke positive feelings related to the physical activity exercise as this need was identified during the focus group sessions. For example, "…I then walk to the living room and can see my exercise bike…I start to move my right foot on the pedal, then my left foot. I feel my legs and feet moving in a circular motion... This makes me feel good, as I know I have done well and am contributing to my goal. Time passes and I notice on my screen that I have been exercising for 30 minutes. Now that I am finished, I get off my bike. I see myself smiling as I feel good as I have made a positive contribution towards burning more energy to help me lose weight."

Summary. The third stage of the development and pilot of the weight-loss program, consisted of redeveloping the weight-loss intervention using the thematic analysis data, and re-recording the intervention to reach a professional level. The intervention program was amended based on the feedback contained within the area of the nine identified themes that resulted from the thematic analysis of the data obtained from the two focus group sessions. The HEALTHI program intervention changes were approved after undertaking a process of review, feedback, and editing by two expert academic reviewers and two members of the community. The final version of the HEALTHI program script is provided in Appendix G. In addition, the HEALTHI program is available to view online on Open Science Framework from osf.io/vepsr. As the researcher facilitated the two focus group sessions it is important to note that this may have potentially influenced participants' willingness to reflect

on the presenter's credibility, reliability, and likeability which are traits that enhance program quality and have been identified as implicit drivers of participant receptiveness and engagement in intervention programs (Morgan, Young, Smith, & Lubans, 2016). Despite this possible limitation, the focus group sessions were conducted with the researcher with the notion that the benefits of gathering any information will still provide an advantage to the program development. An important component of qualitative research is the explicit acknowledgement of the contribution and background of the researcher. Research adopting this method type recognises and acknowledges that there is bias when gathering and interpreting the data, and data are interpreted in light of these inferences. Given that the focus group sessions were conducted by the researcher due to direct involvement in program development and design, it was deemed necessary to provide all focus group participants with the names and details of the program supervisors whom they could contact if they wished to provide additional feedback that the participants did not want to provide to the researcher during the focus group sessions.

CHAPTER THREE: The HEALTHI Randomised Control Trial Study Protocol

Introduction to Study Protocol

This chapter provides an overview of the HEALTHI program study protocol which was published in a truncated form as a journal article:

Hattar, A., Hagger, M. S., and Pal, S. (2015). Weight-loss intervention using implementation intentions and mental imagery: A randomised control trial study protocol. *BioMed Central Public Health, 15,196.* doi:1186/s12889-015-1578-8.

The accepted manuscript version of the article is provided below[1]. Details of additions not included in the original article and supplementary information are outlined in an amendments section following the article.

Weight-Loss Intervention Using Implementation Intentions and Mental Imagery: A Randomised Control Trial Study Protocol

Abstract

Background. Overweight and obesity are major health problems worldwide. This protocol describes the HEALTHI (Healthy Eating and Active LifesTyle Health Intervention) Program, a 12-week randomised-controlled weight-loss intervention that adopts two theory-based intervention techniques, mental imagery and implementation intentions, a behaviour-change technique based on planning that have been shown to be effective in promoting health-behaviour change in previous research. The effectiveness of goal-reminder text messages to augment intervention

[1] Permission to reproduce this transcript in the thesis was granted from the copyright owner (Appendix A).

effects will also be tested. The trial will determine the effects of a brief, low cost, theory-based weight-loss intervention to improve dietary intake and physical activity behaviour and facilitate weight-loss in overweight and obese individuals.

Methods/Design. Overweight or obese participants will be randomly allocated to one of three conditions: (1) a psycho-education plus an implementation intentions and mental imagery condition; (2) a psycho-education plus an implementation intentions and mental imagery condition with text messages; or (3) a psycho-education control condition. The intervention will be delivered via video presentation to increase the intervention's applicability in multiple contexts and keep costs low. We hypothesise that the intervention conditions will lead to statistically-significant changes in the primary and secondary outcome variables measured at 6 and 12 weeks post-intervention relative to the psycho-education control condition after controlling for baseline values. The primary outcome variable will be body weight and secondary outcome variables will be biomedical (body mass, body fat percentage, muscle mass, waist-hip circumference ratio, systolic and diastolic blood pressure, low-density lipoprotein, high-density lipoprotein, total cholesterol, triglycerides, blood glucose and insulin levels), psychological (quality of life, motivation, risk perception, outcome expectancy, intention, action self-efficacy, maintenance self-efficacy, goal setting and planning), and behavioural (self-reported diet intake, and physical activity involvement) measures. We also expect the intervention condition augmented with text messages to lead to statistically significant differences in the primary and secondary outcome variables at the follow-up periods after controlling for baseline values.

Discussion. The planned trial will test the effectiveness of the theory-based HEALTHI program to reduce weight and salient psychological, biomedical, and

behavioural outcomes in overweight and obese adults. The study has been designed to maximise applicability to real world settings and could be integrated into existing weight management practices.

Background

The problem of overweight and obesity. Obesity and overweight are linked to major chronic illnesses and conditions like cardiovascular disease, diabetes, and certain cancers (WHO, 2012). It is recognised as a global problem with obesity rates worldwide having nearly doubled since 1980 (WHO, 2012). This has led researchers to develop effective means to assist obese and overweight individuals to reduce their weight and, in doing so, their risk of chronic illness. The main cause of weight gain is an imbalance between the amount of energy consumed and expended by individuals. Wing and Hill (2001) report that weight-loss can only be achieved through a negative energy balance, decreasing energy intake by restricting food or increasing energy expenditure through daily activity. Based on current evidence, weight-loss strategies that include a combination of a reduced calorie intake diet and increased physical activity appear to be most effective (Blackwell, 2002; Foreman, 2009). The current article will discuss the development of a brief, cost effective, theory-based intervention using implementation intentions and mental imagery techniques to target dietary intake and physical activity behaviour to promote weight-loss. The intervention will involve minimal direct contact between participants and practitioner and will use resources that can easily be ‘rolled-out’ in ‘real world’ contexts. The intervention will use the Health Action Process Approach (HAPA) (Schwarzer, 2008) as a theoretical basis for intervention content and to explain the

mechanisms behind the proposed effects. The intervention will also incorporate the use of goal-reminder text messaging to augment the intervention effectiveness.

Diet, physical activity, and weight-loss. Research suggests that combining a calorie-reduced diet and regular physical activity will be effective in achieving weight-loss and preventing obesity-related risk factors (Blackwell, 2002; Donnelly et al., 2009; Mitsui et al., 2008; Rodriguez, 2011; Shaw et al., 2006). Reducing 500 calories per day can assist with a weight-loss of approximately 0.5 kilograms a week (Fernau, 2010; Metric Conversions, 2003). Fernau (2010), suggests that one strategy that individuals may use to manage the consumption of food is to count daily calories. Some of the methods to assist with calorie counting are to spread calories throughout the day, read labels including the serving size and calories per serving, use a calorie counter such as a book or website, and monitor daily food and drink intake such as through the use of a food diary (*see* Fernau, 2010, for more information).

Engaging in regular physical activity is also an important part of an effective strategy to assist an individual to expend more calories than the body requires thereby contributing to weight-loss. Exercise can assist in improving risk factors associated with cardiovascular disease even in the absence of weight-loss (Ho, Dhaliwal, Hill, & Pal, 2011; Ho, Dhaliwal, Hills, & Pal, 2012a; Mitsui et al., 2008; Shaw et al., 2006). Physical activity guidelines in America and Australia recommend that adults engage in a minimum of 30 minutes of moderate activity on most or all days of the week to receive health benefits (Norton et al., 2010). A combination of changes in dietary intake and physical activity behaviour will likely be most effective in assisting an individual to lose weight (Blackwell, 2002; Foreman, 2009).

Changing health behaviour. For health professionals to support clients to

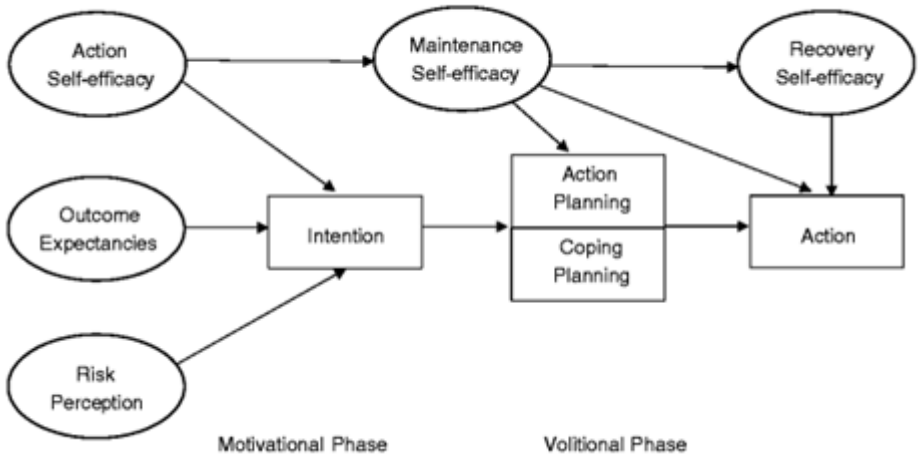
lose weight, it is necessary to identify the factors related to health-related behaviour change and use them as a basis for intervention design (Hagger & Hardcastle, 2014; Michie, 2008). These factors are outlined in many different behaviour change models, particularly social psychological models which aim to explain intentional and motivated behaviour that have been applied to predict and understand health behaviour (Behaviour Change and Communications Team, 2009). Researchers seeking behavioural solutions to health-behaviour need to target psychological factors that are considered changeable and malleable to evoke health-behaviour change. These psychological factors can be targeted by sets of behaviour-change techniques that can evoke a change in the psychological factors linked to health behaviours (Michie & Abraham, 2008; Michie et al., 2013).

The current intervention adopts the HAPA (Schwarzer, 2008), an integrated social psychological model that has been widely used to identify the components related to changes in weight-loss behaviours and how components can be used to inform the intervention content to ensure the change process is clearly identified (*see* Figure 3.1).

The HAPA states that the process of health behaviour change consists of two phases: a motivational phase that leads an individual to form the intention to change their behaviour, and a volitional phase that leads the individual to performing the actual behaviour (Schwarzer, 2008). Two strategies that map closely on to the volitional and motivational phases of the HAPA include implementation intentions and mental imagery, respectively. The intervention components are designed to target both the motivational and implemental phases of the HAPA. The components are proposed to lead to optimal behaviour change by providing individuals with the confidence and motivation to engage in the behaviour, as well as the capacity to

convert motivation into actual behaviour change (Hagger, Lonsdale, Koka, et al., 2012).

Figure 3.1. Health Action Process Approach Model (Schwarzer, 2008).



Mental imagery has been found to increase an individual's confidence in their ability to change their behaviour (self-efficacy), which relates to the motivational phase in the HAPA. Mental imagery can be categorised as either outcome imagery or process imagery, both which have different implications for goal attainment (Hagger et al., 2011; Hagger & Luszczynska, 2014; Knäuper et al., 2011). Outcome imagery is based on imagery related to the experience of goal achievement and success, and therefore is a motivational approach for improving goal achievement. Process imagery is based on imagery related to the steps needed to achieve the desired outcome, which according to Pham and Taylor (1999) is mainly a cognitive planning strategy (Hagger et al., 2011). Implementation intentions are action plans that state when, where, and how an individual intends to reach a goal and promotes action planning, bridging the gap between having the intention to change behaviour and performing the behaviour, consistent with the volitional phase of the HAPA

(Gollwitzer, 1999; Hagger, Lonsdale, Koka, et al., 2012). To target changes in diet and physical activity behaviours for weight-loss, the combined use of implementation intentions and mental imagery have been found to be an effective method (Knäuper et al., 2009).

Mobile phone text messaging is a widely available, cost effective, and an instant tool that has been recently applied to promote health behaviour change and to increase intervention effectiveness (Cole-Lewis & Kershaw, 2010). Support for the use of text messages to increase intervention effectiveness is found within various studies exploring the outcome of weight-loss (Haapala et al., 2009; Patrick et al., 2009; Prestwich et al., 2010). For example, Prestwich and colleagues (Prestwich et al., 2010) developed an intervention aimed in promoting brisk walking among sedentary individuals. The researchers found that pairing implementation intentions with goal-reminder text messages assisted participants in increasing walking frequency and weight-loss. Text messages which include goal reminders may enhance the effectiveness of both implementation intentions and mental imagery steps, respectively within the volitional and motivational phase of the HAPA; The use of text message goal reminders can serve to "boost" the effectiveness of these intervention components as that may assist participants in recalling their goals and plans increasing their commitment to action them, as well as increasing one's confidence to change their behaviour.

The Present Study

The purpose of the current study is to develop and evaluate the HEALTHI (Healthy Eating and Active LifesTyle Health Intervention) program, a theory-based intervention to change dietary intake and physical activity behaviours, and promote

weight-loss and the reduction of obesity-related health risk factors in a sample of overweight and obese individuals. The key behavioural outcome will be changes in body weight through engagement in, and adherence to, a calorie-restricted diet and participation in 30 minutes of daily physical activity. Although a number of studies have incorporated the use of implementation intentions and mental imagery to promote health behaviour (Hagger et al., 2011; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger & Luszczynska, 2014; Knäuper et al., 2011) the present intervention will incorporate the use of both strategies to promote both diet and physical activity guidelines adherence. The inclusion of both strategies acting synergistically with multiple longer-term follow-up of biomedical, behavioural, and psychological outcomes is a unique aspect of the current intervention and will contribute to knowledge by demonstrating whether these techniques are effective in bringing about weight-loss and other outcomes changes.

The present intervention will also incorporate the use of technology, augmenting the effectiveness of the intervention with goal-reminder text messages delivered by mobile phone. The use of multiple strategies in achieving weight-loss goals including implementation intentions, mental imagery and text message goal reminders is a unique aspect of the current study. Pairing implementation intentions with text message goal reminders has been shown to be successful for weight-loss and participation in physical activity (Prestwich et al., 2010); the aim of the study is to not only deliver implementation intention, but also mental imagery goal-reminder text messages based on the HAPA. This is important as research has shown that only a few studies using text messaging for behaviour change in disease prevention and treatment had a theoretical rationale to guide various interventions (Cole-Lewis & Kershaw, 2010). This will be the first study to demonstrate the use of both text

messaging with implementation intention and mental imagery in weight management. This will address a specific gap in the research literature regarding weight management and will contribute to knowledge by testing the proposal that introducing multiple theory-based behaviour-change strategies alongside a standard weight-change intervention program will improve the effectiveness of the intervention (Michie & Johnston, 2012; Taylor et al., 2011).

Hypotheses. The main hypothesis is that the intervention conditions adopting implementation intentions and mental imagery techniques, will result in statistically-significant independent improvements in the outcome measures relative to the control condition from the time of intervention and at 6 and 12 weeks. We also expect statistically-significant differences in the outcome variables across the two intervention conditions, such that the intervention condition with text messages leads to greater weight-loss that the intervention condition alone.

It is also hypothesised that relative to baseline and week 6 and 12, the intervention with text message condition will lead to statistically-significant independent improvements on the biomedical, psychological, and behavioural outcome measures, compared with the intervention and control conditions. In particular, we expect to find statistically-significant differences in the key HAPA-based psychological mediators of the effects of the intervention components including planning (relevant to implementation intentions) and self-efficacy and motivation (relevant to mental imagery) over the same follow-up time points.

Methods and Design

Design. A randomised-controlled design will include obese and overweight participants randomly allocated to one of three conditions: A psycho-education

control condition (control condition), an implementation intention and mental imagery techniques condition (intervention condition), and an implementation intention and mental imagery techniques with text messages condition (intervention with text message condition). Figure 3.2 displays the design of the intervention and proposed participant flow through the study. The 12-week study will examine the effects of the intervention on biomedical, psychological, and behavioural outcome measures at baseline and post-intervention (at 6 and 12 week follow-ups). The study information and intervention manipulations will be delivered via a video presentation viewed at baseline. See Table 3.1.

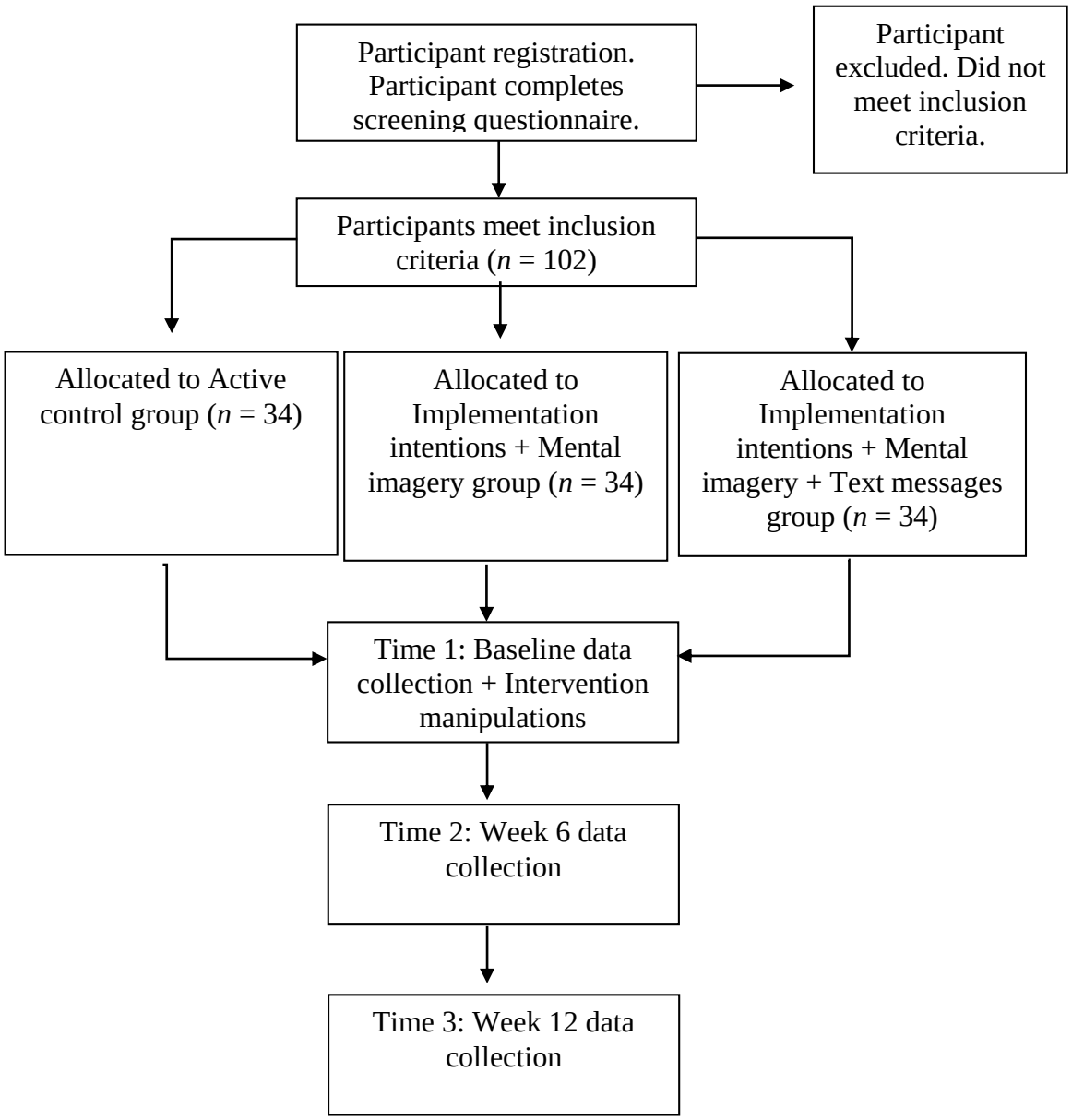
While viewing the video intervention manipulations participants will be asked to complete various activities such a goal setting. The responses to the intervention activities will be emailed to the research team to indicate program compliance and adherence. Ethical approval for the trial has been obtained from Curtin University's Human Research Ethics (approval number: HR137/2013). The trial has been registered on ANZCTR (Trial number: ACTRN12613001274763).

Table 3.1

Study components specific to each condition

Conditions		
Control	Intervention	Intervention with text message
Study information	Study information	Study information
Psycho-education	Psycho-education	Psycho-education
Weight loss guidelines	Weight loss guidelines	Weight loss guidelines
	Implementation intentions	Implementation intentions
	Mental imagery	Mental imagery
		Text messages

Figure 3.21 *Participant flow diagram*



Participants. Participants will be recruited via the Curtin University website and email system, flyers in local community organisations, a Western Australian Newspaper and a social-networking website. Eligible respondents recruited via these procedures will be provided with study information and an online link to a corresponding online questionnaire (Qualtrics™). Participants will be directed to complete the online screening questionnaire to ensure they meet the study inclusion criteria. Participants are eligible for inclusion if they are aged between 18 and 65 years, overweight or obese, defined as a body mass index (BMI) of between 25 and 40, and cite a willingness to have blood samples and body composition scans taken. Study exclusion criteria include serious health conditions, inability to engage in any form of physical activity, pregnancy, severe depression, inability to commit to follow-up clinic sessions, or no access to a mobile phone with text message features. A comprehensive list of the inclusion and exclusion criteria is provided in Appendix H.

Participants that meet the study inclusion criteria will be invited to attend an initial orientation session at the Curtin University clinic to provide them with study information. Individuals are then given an opportunity to officially enrol in the program at the orientation session. Prior to their first clinic appointment the participants will be directed to complete baseline measurements.

Intervention Protocol

Procedure. The study will adopt a double-blind procedure so that both the participant and researcher are unaware of the intervention conditions to which they have been assigned. A research assistant naïve to the purpose of the study will ensure each participant is provided with a participant identification number and randomly

allocated to one of the three conditions using a computer-generated schedule (Urbaniak & Plous, 2013). The intervention information and procedures for each of the three conditions will be determined by the allocated condition and participants will be required to access the video presentation corresponding to their allocated condition. Participants in the intervention with text message condition, will have their participant identification number matched to their mobile phone number. The mobile numbers will be entered on a text message system to allow the researcher to send participants their weekly text message goal reminders.

Participants will need to provide written consent prior to participation. Prior to each clinic appointment participants will complete questionnaires measuring baseline psychological and behavioural outcomes including a 3 day food, drink, and exercise diary. Within a three day period, prior to their clinic appointment, participants will be required to attend to a pathology clinic to take blood sample measures. Furthermore, at each clinic appointment participants will engage in baseline biomedical assessments: blood pressure, weight, waist-hip ratio, and at baseline and week 12 body composition measures. At the first clinic appointment participants will be asked to view a pre-recorded video presentation that contains the intervention information, followed by the completion of a questionnaire containing the post-intervention measures. One of two video presentations will be provided to participants, one designed for the control condition participants, and the other for the two intervention conditions. The duration of the video presentation is approximately 60 and 76 minutes for the control and intervention conditions respectively. Due to the pauses in the video to complete various activities and the break time the intervention manipulation duration may last approximately 90 to 120 for the control condition, and 150 to 210 for the intervention conditions. In addition, participants

allocated to the intervention with text message condition will receive goal-reminder text messages over the 12 weeks of the intervention. Prior to leaving the clinic, all participants will be provided with their future appointment times and a set of tools to assist them with monitoring their physical activity and calorie intake: A copy of the Calorie King™ book (Borushek, 2013a), Calorie Counter diary (Borushek, 2013b), the Australian dietary guidelines (2013), and Australian physical activity guidelines (Department of Health, 2014). Participants will be encouraged to contact the researcher if any queries arise. In addition, a personalised email providing a handout of the essential program information such as the guidelines and the participant's responses to various activities (including goals) when watching the video presentation will be sent to the participant via email. The participant responses to the activities will be assessed by the research team to ensure program compliance.

Intervention Components

Weight-loss information for all participants. Participants will be presented with a psycho-educational component common to all intervention conditions followed by, if assigned to the intervention conditions, the behaviour change components based on the HAPA. The components will be delivered by an interactive video presentation by an investigator. Table 3.1 outlines the components specific to each of the three study conditions.

The significance of adopting theory-based intervention techniques delivered by video means that the intervention is evidence-based, cost effective, requires minimal contact with the participant, provides flexibility for delivery, and is easily available. The video presentation allows messages to be conveyed in a consistent manner and reduces experimenter bias and provides greater control over potential

variation in delivery across participants. All participants will receive identical content in relation to study design, psycho-education information, dietary intake and physical activity guidelines. Thus differences between the control and intervention conditions can be attributed purely to the intervention components. The participants in the two intervention conditions will receive the same information regarding the mental imagery and implementation intentions instructions, and thus differences in these intervention conditions can be attributed to the goal-reminder text messages and not differences in intervention delivery style.

The main components of the video presentation are outlined below. The pre-recorded video presentation provided to participants within all conditions, will introduce participants to study information and basic concepts of weight-loss including psycho-education. The participants will be informed that they will be required to adhere to two guidelines for physical activity and dietary intake, respectively, in accordance with the weight-loss intervention. The physical activity guideline encourages participants to exercise and be physically active. Participants will be instructed to *"engage in physical activity and be as active as possible. Engage in a minimum of 30 minutes of planned daily exercise"* in accordance with the Australian physical activity guidelines (2014). Participants will be provided with examples of physical activity and exercise, and be informed that more intensive exercise will assist them in reaching their weight-loss goal. Participants will be instructed to record some goals related to the physical activity guidelines.

The dietary intake guideline encourages participants to monitor their energy intake. The participants are instructed: *"monitor your energy intake and ensure your calorie (or kilojoule) intake amount is somewhere in-between the minimum and maximum allowance."* Each participant will be provided with an individually

recommended daily calorie intake amount needed for weight-loss. The Katch-McArdle Formula will be used to calculate the minimum amount of energy needed for one's body to function, or the calories needed to maintain ones weight, referred to as basal metabolic rate (BMR), (Boston, 2013). The Katch-McArdle formula takes into consideration an individual's lean body mass. (BMR = 370 + (21.6 × lean mass in kg). Total daily energy expenditure is calculated by multiplying the BMR to a number representing the individual's physical activity level. The outcome is subtracted by 500 calories to provide individuals with the recommended number of calories needed to consume to achieve weight-loss (Fernau, 2010). Participants' calorie intake allowance will be recalculated at week 6 to account for body weight changes. To assist in meeting their daily recommended calories allowance, participants will be provided with information on the definition of a calorie, information on calories versus kilojoules, how to calorie count, how to use a calorie counting book, suggestions on food and drink consumption to assist in remaining within a participant's daily calorie allowance, how to ensure a healthy diet including information on the Australian dietary guidelines (1998), and examples of healthy eating. Participants will be instructed to record some goals related to the dietary intake guidelines.

Components for intervention conditions. The pre-recorded video presentation provided to participants in the intervention conditions will also include the mental imagery and implementation intentions intervention components. Participants will be asked to create implementation intention plans using an if-then format (Hagger, Lonsdale, Koka, et al., 2012). Participants will be provided with instructions to guide them to mentally imagine the steps needed to reach their goals, and the goal outcome. Participants will be directed to record their goals, if-then

plans, and mental imagery steps. Information on the development of the behaviour-change intervention components based on the HAPA is outlined below.

Research has highlighted the importance of outlining details of the behaviour change techniques used in behavioural interventions in relation to how they fit the theory (Bartholomew et al., 2001; Lloyd, Logan, Greaves, & Wyatt, 2011; Michie & Abraham, 2008; Michie & Johnston, 2012). This allows for an understanding of the content that an intervention uses, the methods, and the 'active ingredients' that lead to behaviour change. Michie and Prestwich (2010) also highlight the importance of not only using theory to guide an intervention, but also identifying the theory components that relate to the intervention techniques.

Table 3.2 provides details of our systematic method of matching the study techniques with the theoretical components; this allows for better understanding of how the theory informs the intervention design and assists in evaluating the intervention effectiveness and theory (Bartholomew et al., 2001; Michie & Prestwich, 2010). The table includes the behavioural objective or target behaviour to be changed such as the diet or physical activity guideline, the theory-based psychological concept employed, the behaviour change technique within the theoretical framework that relates to the objective, the strategies that will be used in the present study linking the performance objective and behaviour change technique, and the evaluation method, such as the questionnaires or tools that will be used to evaluate whether the strategies employed resulted in changes in the theoretical construct to which it pertained. For example, the objective "monitor your energy intake to ensure your calorie (or kilojoule) intake is somewhere in-between the minimum and maximum allowance amount" is listed as the behavioural objective or behaviour needed to be changed (Table 3.2).

Table 3.2

Systematic Process Matching Behaviour-Change Technique with Theoretical Components for the HEALTHI program

Objective / Behaviour	Psychological variable targeted	Behaviour Change Technique (Theoretical Framework)	Implementation Strategies	Evaluation
1. Diet: *Monitor your energy intake and ensure your calorie (or kilojoule) intake amount is somewhere in-between the minimum and maximum allowance amount.*	Risk perception	Information provision.	Provide information on obesity related health factors.	Questionnaire items measuring Risk perception.
	Planning	Implementation Intentions	Participants create If-then plans on: how they plan to count calories, and how to keep calories to a minimum	Questionnaire items measuring planning and level of If-then plan.
	Self-efficacy and motivation	Mental Imagery	Participants are directed to imagine the steps needed to reach their If-then plan. For example, imagining that they want to have a fatty food, and then imagine the steps required to implement their implementation intentions that target this obstacle.	Questionnaire items to measure self-efficacy and motivation.
2. Physical Activity: *Engage in physical activity and be as active*	Risk perception	Information provision	Provide information on obesity related health issues and benefit of physical activity.	Questionnaire items to measure risk perception.

as possible. Engage in a minimum of 30 minutes of planned daily exercise.	Planning	Implementation Intentions	Participants create If-then plans on how they will engage in exercise, and what exercise they will perform.	Questionnaire items to measure planning and level of the If-then plan.
	Self-efficacy and motivation	Mental Imagery	Participants are directed to imagine the steps needed to reach their If-then plan.	Questionnaire items to measure self-efficacy and motivation.
Information on objectives needed for both Goal 1 (dietary intake) and Goal 2 (physical activity)	Evaluation	Self-evaluation	Self-monitor dietary intake and physical activity involvement.	Food, drink, and exercise diary. Questionnaires to measure dietary and physical activity behaviour. Body weight measurements
	Outcome expectancies (subjective beliefs about unforeseen events of a person's behaviour with succeeding outcomes. That is, a person's expectations about the consequences of an action).	Information provision	When changing behaviour, the outcomes are viewed as being negative or positive (e.g., weight-loss) and this influences intention to engage in target behaviour (exercise, diet). Information on positive outcomes of weight-loss and engaging in diet and exercise.	Questionnaire items to measure outcome expectancy.

Note. Delivery mode = intervention delivered via online Qualtrics™ with incorporated video presentation. One condition will receive goal-reminder text messages. Intensity time = participants are asked to view the intervention once and complete the various activities incorporated within the intervention. Setting = Clinic room within Curtin University.

The intervention components are based on theory-based psychological concepts: risk perception and planning. The planning variable target is matched with the behaviour change techniques of implementation intentions. The implementation intentions relate to the use of the strategy of directing participants to create if-then plans in relation to the diet guideline. The strategy will be evaluated by having participant's complete self-reported questionnaires on planning and the if-then plan will be evaluated by the researcher.

Text message intervention component. Participants in the intervention with text message condition, will receive a text message once a week for a total of twelve weeks. The text message content will include goal reminders that relate to the participant's diet and physical activity goals, implementation intentions and mental imagery that were set at baseline. For example: "Hello. I would like to ask you to take the time to review and remember your goals and the steps you need to take to reach them. Try and remember (or refer to your HEALTHI Program handouts) when you imagined the steps for your dietary intake and physical activity/exercise goals when watching the video? Take a few minutes to imagine these steps to reach your goals so it is clear in your mind."

Assessments

Multiple measures of biomedical, psychological, and behavioural outcomes and measures will be used to assess the intervention effectiveness; these are discussed below.

Biomedical outcomes. Key outcome biomedical outcome measures will be taken to monitor changes in cardiovascular disease risk and body weight and

composition as a result of the intervention (Mitsui et al., 2008; Pal, Khossousi, Binns, Dhaliwal, & Ellis, 2011; Shaw et al., 2006). All the biomedical outcome measures will be conducted at baseline, 6 and 12 week periods unless specified otherwise. Within a three day period prior to the clinic appointment, blood lipoproteins including low-density lipoprotein (LDL), high-density lipoprotein (HDL), total cholesterol (TC), triglycerides, and blood glucose and insulin levels will be taken at an approved pathology laboratory using a venous blood sample from each participants.

Body weight (kg) will be recorded with participants wearing light clothing and no shoes, using a digital body composition monitor scale (Omron, model HBF 362). *Height (cm)* will be measured at baseline, to the nearest 0.1 cm using a stadiometer with participants wearing light clothing and no shoes. *Body mass index (BMI)* will be calculated using both the weight and height measurements using the formula weight in kilograms divided by the square of the height in meters (kg/m2). *Waist-hip ratio (cm)* will be calculated by measuring waist circumference in standing position at the narrowest area between the iliac crest and lateral lower rib, and hip measurement from the largest circumference of the lower abdomen. This will be measured to the nearest 0.1 cm using a circumference measuring tape (Seca 203). To ensure greater accuracy the measure will be taken twice and the average of the two readings will be used.

Systolic blood pressure (SBP) and *diastolic blood pressure (DBP)* will be measured using an automated, blood pressure monitor (A & D Medical, model UA-851) with participants in a supine position with the tested arm at the level of their heart for at least a minimum of 10 minutes before and during measurements (Pal &

Radavelli-Bagatini, 2013). The measure will be taken three times and the average reading will be used. Body composition including *bone mass, body fat percentage,* and *muscle mass* will be measured using the whole body dual-energy X-ray absorptiometry (DEXA, Lunar Prodigy; Lunar, Madison, WI, USA). Participants will be required to lie on a bed during the DEXA scanning with no jewellery or metal clothing. DEXA scans will be performed at baseline and 12 weeks. The dual-energy X-ray absorptiometry machine will be calibrated and a phantom scan undertaken daily.

Behavioural outcomes. A number of behavioural outcome measures will be taken at baseline, 6 and 12 weeks, unless otherwise specified. The 24-item *Bailey Dietary Screening Questionnaire* will be used to identify nutritional risk. Three levels of nutritional risk include: at risk, possible risk, and not at risk. The measure has been found to have adequate sensitivity and specificity when compared with nutritional risk based on dietary reference intakes (Bailey et al., 2009). Sensitively measures indicate that 83% of individuals were correctly classified as positive by the screening tool. Specificity measures indicated 75% of individuals correctly classified as negative by the screening tool. An example item from the questionnaire is: “how often do you usually eat fruit as a snack?” Participants are asked to respond on a Likert scale ranging from 0 (never) to 4 (3 or more times a week).

An 18-item version of the *Three Factor Eating Questionnaire,* (TFEQ-R18), will be used to measure eating behaviour examining three cognitive and behavioural domains of eating; these include cognitive restraint, uncontrolled eating, and emotional eating. Good reliability has been reported (Cappelleri et al., 2009). An example of an item within the emotional eating scale includes “I start to eat when I

feel anxious." The item response occurs on a 4-point Likert scale from 1 (definitely true) to 4 (definitely false).

Physical activity and diet intake diary were provided to participants; prior to each clinic visit, participants will complete a three consecutive day record of their physical activity and dietary intake. Participants will complete the 'food, drink and exercise diary' record including one weekend and two weekdays (Pal & Ellis, 2010). For the physical activity section, participants will complete a 3-day activity log adapted from Bouchard and colleagues (Bouchard et al., 1983). Participants will record an activity code from 1 to 9 that corresponds to the physical activity carried out during each five minute period; the time and activity of physical activity is thus recorded. In addition, participants will record their belief about the accuracy of their physical activity log. The physical activity log information will be assessed by examining energy expenditure. Each activity code is related to various levels of Metabolic Equivalent. The measure has been found to have high reliability with a coefficient of 0.96. For the food diary intake section, participants will record a 3-day food log containing information about their drink or food intake, time consumed, location, amount, drink or food description and method of preparation, and belief about the accuracy of their food log. The diary will be used to evaluate the participant's compliance with the recommended diet and physical activity guidelines. The program Food Works will be used to analyse the food content and nutrients (Pal & Ellis, 2010).

Self-reported intervention compliance questions were also incorporated at week 6 and 12. The five items will be used as a measure of the participant's self-reported compliance to the behaviour changes of dietary intake and physical activity.

For example, “on average, during the past 6 weeks, how often did you engage in at least 30 minutes of planned exercise?” with item responses ranging from 1 (7 days/week or Always) to 5 (Never).

Psychological measures. Participants will be instructed to complete the outlined psychological measures before and after viewing the video presentation intervention unless specified otherwise. Variables from the HAPA will be measured to assess the psychological mediators that may explain the effects of the intervention on the behavioural and biomedical outcomes. The HAPA measures include items adapted from Barg and colleagues’ (2012) measure of assessing risk perception for developing cancer for physically inactive middle aged adults. *Risk perception* will be assessed using four items on a 6-point Likert scale ranging from 1 (strongly disagree, much lower, not likely) to 6 (don’t know/refused) to measure perceived risk of developing obesity-related risk factors. For example, “I think it is likely that I will develop health problems related to obesity at some point in my life.” *Outcome expectancy* will be assessed using six items with responses ranging from 1 (strongly disagree, not at all effective) to 5 (strongly agree, extremely effective) to question participants about the effect of diet and physical activity on health risks related to weight gain. For example, “I think that consuming fewer calories per day is a very important way to help me to lose weight.” *Intention* will be assessed with four items that ask participants how much they plan and intend to follow the diet guidelines and/or to participate in the recommended physical activity amount over the next 12 weeks. Responses range from 1 (strongly disagree) to 5 (strongly agree). For example, “I intend to participate in daily physical activity with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks.

Action self-efficacy will be measured using 10-items regarding participants' confidence and ability to engage in the recommended diet and physical activity guidelines over the next 12 weeks. Prior to answering the questions, participants would have heard the recommendations during the video presentation. Items are on a 5-point Likert scale ranging from 1 (not confident, not likely, strongly disagree) to 5 (completely confident, extremely confident, strongly agree). For example, "if it were entirely up to you, how confident are you that you would be able to follow a diet that requires you to consume fewer calories per day on each individual occasion over the next 6 weeks?" *Maintenance self-efficacy* will be measured using 18-items on a 5-point Likert scale ranging from 1 (not confident) to 5 (completely confident) to measure barriers to engage in the recommended physical activity or diet guidelines. For example, participants were asked "How confident are you that you will do daily physical activity with a minimum of 30 minutes of planned exercise during your leisure time on each individual occasion over the next 6 weeks even if…" followed by a list of barriers, such as, but not limited to bad weather and feeling tired. The participants *planning* will be assessed using two items ranging from 1 (strongly disagree) to 5 (strongly agree) that ask participants if they had made a detailed plan about when, where and how they would engage in physical activity or follow the diet guidelines. For example, "I have made a detailed plan about when, where, and how I will do daily physical activity with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks."

Further variables that relate to the HAPA were adopted from Hagger and colleagues (Hagger, Lonsdale, & Chatzisarantis, 2012). *Motivation* will be assessed at baseline by asking participants to respond to six items that question motivation to

participate in physical activity and change their diet. For example, “how motivated are you to change your diet on each individual occasion over the next 12 weeks?” Item responses are based on a 6-point Likert scale ranging from 1 (not at all motivated, no effort at all) to 6 (extremely motivated, all my effort). In addition, four items exploring engagement in mental imagery exercises will be used. Participants will be asked to indicate the level to which they were able to imagine the task. For example, “to what extent did you visualise in your mind (imagine) exactly how you might reach your diet goals (example, consuming fewer calories per day) on each individual occasion over the next 6 weeks?” The items are on a 6-point Likert scale ranging from 1 (indicating did not imagine), to 6 (indicating clearly imagined).

Goal setting will be measured by asking participants six open ended questions. For example, ‘What are your goals for physical activity?’ The answers to these questions will be “coded” appropriately based on whether they are appropriate and realistic. *Intervention checks* will also be included to ensure that participants engaged with and completed the implementation intention and mental imagery exercises appropriately and according to protocol. That is, participants will be asked to record their goals; If-then plans; and a list of the steps they imagined during the intervention process. The answers to these questions will be “coded” appropriately based on whether they are appropriate and realistic. These variables will be measured as they are expected to mediate the key components of the intervention. That is, the effect of the mental imagery component of the intervention variable on the primary and secondary outcomes is expected to mediate the HAPA variables of self-efficacy, motivation, outcome evaluation, and intention. Similarly, the effect of the if-then

plan component of the intervention on the primary and secondary outcomes is expected to be mediated by the HAPA planning variable.

Imagery ability will be measured at baseline as it may moderate the effectiveness of the mental imagery intervention and should therefore be included as a potential covariate. Imagery ability will be measured using the *Betts' Questionnaire upon Mental Imagery* (Sheehan, 1967) is a 35-item questionnaire used to measure the clarity and vividness of their mental imagery ability. The questionnaire instructs participants to imagine, for example "Visualize a mental image of a friend you see on a regular basis" and rate the image vividness on a Likert scale. Sheehan suggests that the measure is valid and has predictive value. The scale has also been found to be reliable (Westcott & Rosenstock, 1976).

The variables of quality of life, *depression, anxiety, and stress* will be measured as control variables to ensure the intervention does not have adverse effects on quality of life or emotion. These variables will be measured using the two listed questionnaires. *The Impact of Weight on Quality of Life* Questionnaire (IWQOL - Lite) is a 31-item version, self-reported measure that assesses the effect of obesity on quality of life in five domains: physical function, self-esteem, sexual life, public distress, and work (Kolotkin, Crosby, & Williams, 2002). For example, a physical function item includes "because of my weight I have difficulty picking up objects" with responses made on 5-point Likert scales ranging from 1 (never true) to 5 (always true). Depression Anxiety Stress Scales-21 (DASS-21) will be used to measure symptoms of depression, anxiety, and stress. At baseline, 6 and 12 weeks, participants will rate their symptoms over the past week by answering 21-items using a 4-point Likert Scale anchored by 0 (did not apply to me at all) and 3 (applied to me

very much, or most of the time) (Lovibond & Lovibond, 1995). An example item from the questionnaire includes “I couldn’t seem to experience any positive feeling at all.”

Statistical Analyses

A series of 3 (condition: control, intervention, and intervention with text message) × 2 (time: 6 and 12 weeks) mixed model multivariate analyses of covariance (MANCOVAs) with time as a repeated measures variable will be used examine the effects of the intention over time on study outcome variables. Baseline measures will be covariates in the model. A separate MANCOVA will be conducted for each set of dependent outcome variables: biomedical, behavioural and psychological. Pending significant multivariate effects, follow-up univariate analysis of covariance (ANCOVAs) will be used to identify differences for individual variables within each outcome set. Post-hoc follow-up tests will also be conducted to locate individual differences at the time intervals. Mediation analyses will be conducted by mediated multiple linear regression analysis with dummy-coded intervention conditions as the independent predictor variables, the constructs from the HAPA included as mediating variables, and the primary and secondary biomedical outcome variables as the dependent variables. Mediation will be confirmed through significant bootstrapped indirect effects using Preacher and Hayes’ (2008) algorithms for multiple mediation and the PROCESS macro. Missing data will be handled by multiple imputations using regression analysis with the Markov-chain Monte Carlo (MCMC) estimation method. In addition, we will adopt a

full intention-to-treat analysis with last measured data points carried forward in order to provide a conservative estimate of the effects.

Sample size has been determined by a power analysis using the G*Power 3.1 Program, suitable to evaluate differences between the three condition levels greater than 10%, with statistical power set at > 0.80 and alpha set at $p < .05$ (Faul, Erdfelder, Buchner, & Lang, 2009). A large effect size is assumed as previous studies that have used implementation intentions and reminder text messages (Prestwich et al., 2010), as well as studies using mental imagery and implementation intentions to increase exercise behaviour (Andersson & Moss, 2011), have found large effect sizes. Given the estimated effect size, the total sample size required post-test is 66 and considering a potential 35% drop out rate and eliminations of cases due to missing data or spoilt questionnaires based on previous trials (Hagger & Luszczynska, 2014), we plan to recruit 102 participants at baseline or until the required sample size has been achieved.

Discussion

The purpose of the current intervention is to examine the effectiveness of an intervention using implementation intentions and mental imagery strategies aimed to promote adherence to diet and physical activity guidelines to assist obese or overweight individuals in achieving weight-loss. The intervention will also evaluate whether mobile phone goal-reminder text messages will be effective in augmenting the intervention effectiveness. The randomised-control trial will consist of participants being randomly allocated to one of three conditions: (1) a psycho-education plus an implementation intentions and mental imagery condition; (2) a

psycho-education plus an implementation intentions and mental imagery condition with text messages; or (3) a psycho-education control condition. The intervention will be delivered via video presentation, an approach that will increase the intervention's applicability in multiple contexts and keep costs low. The research will be guided by the theoretical framework offered by the HAPA to explain the effects of the intervention components and the mechanisms and mediators involved. The key behavioural outcomes will be adherence to a calorie restricted diet and participation in 30 minutes of daily physical activity measured at 6 and 12 weeks post-intervention. The intervention will also explore changes in additional key biomedical (for e.g., body fat, and waist-hip circumference), psychological (for e.g., quality of life, motivation, and planning), and behavioural (for e.g., self-reported diet intake and physical activity involvement) health-related outcomes.

A large number of questionnaires and assessments completed by participants may have the potential to introduce considerable response burden on participants and lead to increased measurement error and affirmation bias. Furthermore, it is possible that only motivated and potentially compliant people will be likely to persist with the study introducing bias to the eventual findings. As with all research the number of measurements selected is a trade-off between collecting adequate data to evaluate the effectiveness of the intervention relative to participant burden and demand. However, it must be stressed that we have put a number of strategies in place to manage the issue of participant burden and allay associated confounding effects. Specifically, during the video intervention manipulation participants will be encouraged to take as many breaks as needed and have the opportunity to pause the video at their own

volition. In addition, following the first appointment most of the measures and assessments will only be completed relatively infrequently i.e. at six-week intervals.

A unique aspect of the present study is the adoption of two key theory-based intervention techniques, implementation intentions and mental imagery, in synergy to assist participants in achieving their weight-loss goals. The inclusion of these components together is consistent with contemporary theory-based on the HAPA that two phases to action exist and the current intervention aims to induce behavioural engagement through the inclusion of components targeting both phases. The theory-related components and concepts outlined in the current protocol are explicitly linked using a systematic intervention-matching procedure providing other researchers with a precise account of the intervention content and its theoretical basis. The current research is also unique as it will examine whether augmenting the intervention using text messages by mobile phone will enhance the effectiveness of the intervention messages. Prestwich and colleagues (2010) paired implementation intentions with text message goal reminders to achieve participant weight-loss and participation in physical activity the current study extends this research by including the motivational intervention component of mental imagery alongside implementation intentions with text messages.

Another unique component of the current intervention is the adoption of a streamlined and efficient study design with low administration and personnel required with intervention delivery being via video presentation. The significance of implementing a theory-based intervention via video presentation means that the intervention is evidence based, cost effective, requires minimal contact with the participant, provides flexibility for delivery, and is easily available. The intervention

may provide health professionals with a means of assisting obese or overweight individuals that seek weight-loss assistance; through providing patients with a copy of the evidence based self-help approach reliance on health professionals may be reduced, saving time and costs for both the consumer and the health professional. In addition, individuals would have the flexibility to access the intervention program at a time of their own convenience, and to view the presentation using multiple devices such as a computer and laptop.

Protocol Study Amendments and Supplementary Information

Minor amendments to the protocol study are outlined below. Amendments were made to the statistical analyses used to examine the data (a change from the protocol paper statistical analyses section). Data were originally proposed to be analysed using a series of 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 2 (Time of measurement: week 6 and 12) mixed model multivariate analyses of covariance (MANCOVAs). The researchers decided to include the baseline data with the time factor instead of controlling for baseline values as a covariate. As a result, the analyses were amended to a series of 3 (Condition: psycho-education weight-loss, intervention, and intervention with text message) x 3 (Time of measurement: baseline, 6 and 12 weeks) MANOVAs with time as a repeated measures variable to examine the effects of the intention on study outcomes. This method allows for the examination of each of the follow-up periods relative to the baseline period.

Due to the modified analysis design, study hypothesis needed to be slightly altered to reflect the statistical method of MANOVA and not control baseline values

and instead include baseline data with the time factor (a change from the protocol paper section hypothesis and abstract). The modified hypotheses are outlined in Chapter 4 which examines the intervention effects. I also discuss the revised statistical power analysis due to changes in the statistical analysis design in Chapter 4. In addition, all the HAPA variable measures required participants to respond to the items based on a six week period (not 12 weeks). The motivation example stated in the article transcript was "how motivated are you to change your diet on each individual occasion over the next 6 weeks?" and not the "next 12 weeks?"

Additional Intervention Protocol Details not in original published paper

This section provides additional details not reported in the published protocol article. This includes reference to various handouts that participants completed as part of the study. Information on how to access a copy of the intervention is also documented.

Participant recruitment and preliminary sessions. Potential participants interested in engaging in the HEALTHI program were required to complete an online screening questionnaire (Qualtrics^{TM}) to ensure they met the study inclusion criteria; a copy of the screening questionnaire is available online on Open Science Framework (Hattar, 2015, November 19)[2]. Participants who met the inclusion criteria were invited to attend an orientation session via an invitation letter (*see* Appendix I). Approximately three orientation sessions were available per month. At the orientation session, the researcher presented on the requirements for the HEALTHI

[2]Available on open science framework from osf.io/vepsr

program including information on the weight-loss method. The orientation session was designed to provide the participants with the opportunity to understand the program requirements and have the answers to any questions, prior to participants providing informed consent and program enrolment. At the orientation session, participants were also provided with the HEALTHI program orientation booklet (*see* Appendix J); the booklet provided an overview of the program, participant information sheet, copy of the three day food, drink, and exercise diary, information on how to keep a food record and a visual tool to estimate food portion size, consent form and clinic appointment confirmation letter. Participants who enrolled in the program were required to complete the three day food, drink, and exercise diary, and the baseline HEALTHI program questionnaires which is available to view online on Open Science Framework (Hattar, 2015, November 19)[3]. Participants were provided with a Pathology request form to obtain a venous blood sample at an approved pathology laboratory within a three day period prior to each of the clinic appointments.

Participant clinic appointments. At the baseline appointment participants engaged in the baseline biomedical assessments, and were required to view the online HEALTHI program which is also available to view on Open Science Framework (Hattar, 2015, November 19). At baseline, after having viewed the HEALTHI program, participants were asked whether "The HEALTHI program provided me with new information that can assist me to lose weight?" Possible participant responses ranged from 1 (strongly agree) to 5 (strongly disagree).

[3]Available on open science framework from osf.io/vepsr

Participants were also asked “Please rate how clear you understood the provided HEALTHI Program information” with possible responses ranging from 1 (very clear) to 5 (very unclear). Following completion of the HEALTHI program participants were emailed the HEALTHI program summary handout which provided an overview of the dietary intake and physical activity guidelines, and essential program information (*see* Appendix K). Participants in the psycho-education, implementation intentions and mental imagery with text message condition were provided with weekly goal-reminder text messages, (text message list provided in Appendix L). In addition, as described in the protocol paper, participants were required to complete the three day food, drink, and exercise diary, and online assessments prior to attending the follow-up clinic appointments; a copy of the survey participants were required to complete at week 6 and 12 is available online on Open Science Framework (Hattar, 2015, November 19)

When completing the intervention online, after each activity (goal setting, and for the intervention conditions implementation intention and mental imagery activities) participants were required to complete a checklist to ensure the activity was completed as per the instructions. For example, following the formulation of goals, participants were asked to check whether their goal was a SMART goal as per the instructions. That is, that the goal was specific, measurable, attainable, realistic and timely. If the participant indicated that their formulated goal was missing one or more of the elements within the checklist, then the participant was directed to re-write their goal. For intervention condition participants, a checklist was used after the implementation intention and mental imagery activities were completed. This was done to ensure participants respectively, created the implementation intention ‘if-

then' plans as per instructions, and used the majority of their five senses when imagining themselves completing the steps to reach their goals. At the conclusion of the HEALTHI program, the participants were invited to attend one of two information sessions held by the researcher. The purpose of the information sessions was to provide participants with information on the intervention condition they were allocated into, intervention condition manipulations, and the study results.

CHAPTER FOUR: Effects of the HEALTHI program on study outcomes

Introduction to Testing the HEALTHI Program Effects

This chapter provides an overview of the HEALTHI program effects on the biomedical, psychological and behavioural outcomes and examination of the main research hypotheses. For the purpose of this thesis the three outcomes are discussed collectively within the chapter to reduce duplication in the background and method sections. The examined intervention effects are written in the form of a journal article to be submitted for publication. In addition, information supplementary to the article is outlined at the conclusion of this chapter.

HEALTHI Program Weight-loss Intervention Using Implementation Intentions and Mental Imagery: Intervention Effects

Abstract

Background. This article determines the effects of the HEALTHI (Healthy Eating and Active LifesTyle Health Intervention), a brief, low cost, theory-based weight-loss intervention to improve dietary intake and physical activity behaviour, on biomedical, psychological and behavioural outcomes in overweight and obese individuals. The intervention adopted, a 12-week randomised-controlled design using two theory-based intervention techniques, mental imagery and implementation intentions to change behaviour. Goal-reminder text messages were also used to augment intervention effects.

Methods/Design. Overweight or obese participants were randomly allocated to one of three conditions: (1) a psycho-education plus an implementation intentions

and mental imagery condition; (2) a psycho-education plus an implementation intentions and mental imagery condition with text messages; or (3) a psycho-education weight-loss condition. The intervention was delivered via video presentations to increase the intervention's applicability in multiple contexts and reduce delivery cost. The assessments were predominantly measured at baseline, and at weeks 6 and 12 post-intervention.

Results. Contrary to hypotheses, there were no significant intervention effects. However, a significant effect for time revealed that participants within all three conditions showed positive improvements over time on some of the biomedical, psychological, and behavioural outcome variables.

Conclusion. HEALTHI led to improvements in some biomedical, psychological and behavioural outcome variables in overweight and obese individuals. However; no intervention effects or differences between the psycho-education weight-loss and two intervention conditions were found. This may be due to participants allocated to the active psycho-education weight-loss condition receiving the psycho-education component and information on setting goals which was sufficient to evoke behaviour change. However; we cannot ascertain that this was the case, and comparison of the psycho-education weight-loss condition to a non-intervention control condition would be necessary to provide further corroborating evidence. The HEALTHI programme was designed to be applicable to real world settings and to be integrated into existing weight management practices.

Background

Weight-loss and obesity-related risk factors. According to the World Health Organisation (2012) the primary cause of overweight and obesity is an imbalance between the amount of energy consumed and expended. Weight-loss occurs when an negative energy balance occurs with decreased energy intake (of energy consumed from food) or increased energy expenditure (through physical activity), (Wing & Hill, 2001). Changes in an individual's dietary intake and physical activity behaviour can achieve a negative energy balance leading to weight-loss (Blackwell, 2002; National Preventative Health Taskforce, 2009; The Diabetes Prevention Program Research Group, 2012a). Weight-loss can assist with reducing obesity-related risk factors, including but not limited to, cardiovascular disease risk factors, lowered elevated blood pressure and total cholesterol (Blackwell, 2002; Wing et al., 2011). In addition, obesity increases risk to various physiological health problems, including diabetes, ischemic heart disease, and some cancers (World Health Organization, 2012). Obesity has also been linked to psychological factors. Research suggests that psychological factors related to obesity include, but are not limited to, increased risk of depression (Dixon et al., 2003; Hill, 2010), low self-esteem, impaired quality of life, and binge-eating disorder (Hill, 2010). Regular engagement in physical activity has also been found to assist with management of depression, anxiety and stress symptoms (Mello et al., 2013; Nieman, 2002).

The use of a theory-based intervention to target health behaviour. It has been found that health behaviours are difficult to change in the absence of theory-based interventions. The current study examined the use of the Healthy Eating and Active LifesTyle Health Intervention (HEALTHI) program, which is a theory-based,

12-week weight-loss program aimed to assist overweight or obese individuals to change their dietary intake and physical activity behaviours to promote weight-loss and the reduction of obesity-related health risk factors (Hattar et al., 2015). The behavioural outcomes identified in the HEALTHI program included adherence to a calorie restricted diet, and to be physically active including participation in 30 minutes of planned daily physical activity (Hattar et al., 2015). The HEALTHI program incorporated the use of mental imagery, implementation intentions, and goal-reminder text messages to target adherence to the behaviour changes of the dietary intake and physical activity recommendations (Hattar et al., 2015).

Both mental imagery and implementation intentions are related to constructs within the health action processes approach model (HAPA; Schwarzer, 2008). The HAPA is a health behaviour model that suggests health-behaviour change is a process which includes a motivational and volitional phase. The model suggests that the motivational phase leads to behavioural intention, and that the volitional phase leads to the change in the health-behaviour (Schwarzer, 2008). The HAPA identifies that individuals do not always act on their intentions, known in the literature as the 'intention-behaviour gap' (Barg et al., 2012; Prestwich et al., 2010). According to the model the formation of an intention constitutes a motivational phase which precedes a volitional phase in which an individual forms an action plan to assist in linking intentions and behaviour (Schwarzer et al., 2003).

The current study applied the HAPA to design an intervention targeting changes in dietary intake and physical activity behaviour using three strategies: mental imagery, implementation intentions, and goal-reminder text messages (see Hattar et al., 2015). The strategies are matched with the key constructs in the HAPA

that are proposed to mediate their effects on outcomes. The HAPA identifies the use of various types of self-efficacy and how they relate to behaviour change (Conner, 2008) which is related to the strategy of mental imagery. Mental imagery is hypothesised to enhance self-efficacy. For example, imagining oneself jogging may increase self-efficacy or confidence to conduct the behaviour by providing individuals with a 'model' of a successful experience. The individual acts as a 'self-model' enhancing their self-efficacy in their ability to engage in the behaviour successfully.

The HAPA also identifies the need for action planning to facilitate change in behaviour (Schwarzer, 2008) which is related to the strategy of implementation intentions. Action planning includes the formulation of plans to include when, where and how the behaviour will be performed. A form of action plans are implementation intentions which are 'if-then' plans that include when, where, and how an individual intends to reach the behavioural goal (Gollwitzer, 1999). For example, the intention to record calorie intake could be written as an implementation intention, "*If* I consume any food or drink at home or outside the house, *then* I will record my calorie intake on my calorie journal (completion of goal)." In the current study, text messages were also included as an intervention strategy, as research has found that text messages increase the effectiveness of weight-loss interventions (Haapala et al., 2009; Patrick et al., 2009; Prestwich et al., 2009; Prestwich et al., 2010). For example, a study conducted by Prestwich and colleagues (2010) examined brisk walking among sedentary individuals, and found that combining implementation intentions with goal-reminder text messages helped the participants improve their walking behaviour and achieve weight-loss. The current study used text message

goal reminders paired with implementation intentions aimed to enhance behaviour-change and improve intervention effectiveness. Detailed information on the HEALTHI program and the application of the HAPA to form the interventions theoretical basis is available in the study protocol (Hattar et al., 2015).

The Present Study. The present study examined the use of the HEALTHI program, a theory-based intervention using mental imagery and implementation intentions to target change in dietary intake and physical activity behaviour to facilitate weight-loss and affect adaptive change obesity-related risk factors in a sample of overweight and obese individuals. The behavioural outcome includes changes in body weight through adherence to, a calorie-restricted diet and participation in 30 minutes of daily physical activity. The study also evaluated whether mobile phone goal-reminder text messages assist in augmenting intervention effectiveness. Intervention effectiveness was examined in relation to changes in biomedical, psychological and behavioural health related outcomes and measures observed at baseline, and week 6 and 12 follow-up periods. The use of multiple techniques in achieving weight-loss goals including implementation intentions, mental imagery and text message goal reminders is a unique aspect of the current study. Previous studies have found that pairing goal-reminder text messages and implementation intentions has shown to lead to weight-loss and engagement in physical activity behaviour (Prestwich et al., 2010); the current study aims to deliver implementation intention, in addition to mental imagery goal-reminder text messages based on the HAPA. The intervention is based on the HAPA model, in an attempt to improve intervention effectiveness due to the intervention design guided by theory, which illustrates the significance of the current study (Michie & Johnston, 2012).

Another significant contribution that the current study makes to knowledge, is that the intervention was delivered using an online system that incorporates the video presentations, intervention activities, and questionnaires. The intervention was, therefore, cost effective, requiring minimal contact, delivery flexibility, and easy access. In addition, this method of delivery ensured that the presented information was consistent in all intervention conditions, reducing experimenter bias.

Hypotheses. We hypothesised that both intervention conditions would lead to statistically-significant changes in the primary and secondary outcome variables measured at 6 and 12 weeks post-intervention relative to the psycho-education weight-loss condition. The primary outcome variable was body weight, and the secondary outcome variables included biomedical (body mass index, body fat percentage, waist-hip circumference ratio, systolic and diastolic blood pressure, low-density lipoprotein, high-density lipoprotein, total cholesterol, triglycerides, blood glucose and insulin levels), psychological (quality of life, symptoms of depression, anxiety, stress, motivation, risk perception, outcome expectancy, intention, action and maintenance self-efficacy, and planning), and behavioural (self-reported diet intake and physical activity involvement) measures. We also expected that the weight-loss psycho-education plus implementation intention and mental imagery intervention condition with text messages would lead to statistically significant differences in the primary and secondary outcome variables at 6 and 12 weeks, compared to the weight-loss psycho-education plus implementation intention and mental imagery intervention condition (with no text messages).

Method

Design. This study examined the effects of the 12-week HEALTHI program intervention on biomedical, psychological, and behavioural outcome variables measures at baseline, week 6 and 12. Overweight and obese participants (n = 74, mean age = 41.10, mean body mass index = 31.13) were randomly allocated to one of three condition including: (1) a psycho-education plus an implementation intentions and mental imagery condition; (2) a psycho-education plus an implementation intentions and mental imagery condition with text messages; or (3) a psycho-education weight-loss condition. The HEALTHI program psycho-education and intervention manipulations were delivered at baseline via an online system using the Qualtrics™ program to incorporate the video presentations, intervention activities, and questionnaires (see Hattar et al., 2015). Ethical approval for the trial was obtained from Curtin University's Human Research Ethics (approval number: HR137/2013). The trial was registered on ANZCTR (Trial number: ACTRN12613001274763).

Intervention condition manipulations. Participants in all study conditions received weight-loss psycho-education and goal setting information. This included demonstrations and examples of healthy eating (and calorie counting) and physical activity. In addition, information was provided on dietary intake and physical activity goal formulation. Participants were required to complete three SMART goals, which means the goal is specific, measurable, attainable, realistic, and timely (Doran, 1981; Fernau, 2010), for both dietary intake and physical activity. Intervention condition participants also received access to the strategies of implementation intentions and

mental imagery, complimented by examples and opportunity to conduct these activities related to their dietary intake and physical activity goals.

Participants within the intervention conditions were asked to record one implementation intention for each of their dietary intake and physical activity goals. In addition, for each goal, intervention condition participants were asked to complete a process mental imagery activity; that is, imagine the steps required to engage in the behaviour and record these steps. In addition, intervention condition participants were required to complete one outcome mental imagery activity; that is, imagine that they have achieved their goal such as to lose weight or to be healthy and record the imagined steps.

Following the completion of each set of activities (goal setting, and for the intervention conditions implementation intentions and mental imagery) participants completed a checklist to ensure the task was completed as per the activity instructions. Participants were shown a checklist which asked the participant if various components were covered when completing the activity. If participants responded that an activity component was missing, then they were required to redo the activity task. For example, for the goal setting activity, after each goal formulation the participants were asked to check that the recorded goal was a SMART goal and that it was specific, measurable, attainable, realistic, and timely. The HEALTHI program also had one intervention condition which additionally received weekly goal-reminder text messages (see Hattar et al., 2015).

Participant recruitment and sample. Participants were recruited in Perth, Western Australia. Individuals aged 18 years or older who were overweight or obese (body mass index between 25 and 40) were eligible to participate. Candidate

participants were screened via an online Qualtrics™ questionnaire with follow-up questions via email or telephone as necessary to ensure study inclusion criteria were met, and to exclude serious or inhibiting medical, health or psychological conditions (see Hattar et al., 2015).

Sample characteristics and demographic data are presented in Table 4.1. Participants assigned to different intervention conditions did not significantly differ on any of the demographic data. The majority of the participants were born in Australia (63.5%) and were of White/Caucasian nationality (75.7%). The majority of participants living arrangements included living with adults with children (43.2%). The majority of the participants were in full time employment (60.8%) and the type of work was predominately sedentary (67.6%). The highest level of schooling for the majority of participants included university or tertiary level (75.7%).

Table 4.1

Demographic Details of Participants

Demographic	Category	Percentage
Place of birth	Australia	63.5%
	Other	36.5%
Nationality	White/Caucasian	75.7%
	Asian	6.8%
	Black/African American	1.4%
	Other	14.9%
	Did not respond	1.4%
Current living arrangements	Living with adults with children	43.2%
	Living with adults without children	33.8%
	Living alone	13.5%
	Living with children without adults	4.1%

	Other living arrangements	5.4%
Employment status	Full time employment	60.8%
	Part time employment	28.4%
	Part time volunteers	2.7%
	Home duties	2.7%
	Both part time volunteer and part time employment	2.7%
	Did not respond	2.7%
Type of work	Predominately sitting	67.6%
	Standing and some walking	16.2%
	Predominately physical	12.2%
	Other	2.7%
	Did not respond	1.4%
Highest level of schooling completed	University or tertiary level	75.7%
	Technical/trade certificate	6.8%
	High school	13.5%
	Some high school	4.1%

Measures. To assess the intervention effects multiple biomedical, psychological and behavioural outcome variables were measured predominantly at baseline and week 6 and 12. These variables are outlined in detail within the HEALTHI protocol (see Hattar et al., 2015) and a brief list provided below. Appendix M provides description of the below assessments and information on each of the score ranges.

Biomedical outcomes. The biomedical outcomes were measured at baseline, week 6 and 12. *Body composition* variables were examined which included body weight (kg) and body fat percentage using a digital body composition monitor scale (Omron, model HBF 362), and waist-hip ratio using a circumference measuring tape (Seca 203). *Blood pressure* variables included systolic and diastolic blood pressure

measured using an automated blood pressure monitor (A & D Medical, model UA-851). In addition, *blood lipoproteins* measured from a venous blood sample at an approved pathology laboratory included low-density lipoprotein (LDL), high-density lipoprotein (HDL), total cholesterol (TC), triglycerides, and blood glucose and insulin levels.

Behavioural outcomes. The behavioural outcomes were taken at baseline, and week 6 and 12. *Nutrition and eating behaviour* related variables include nutritional risk measured from the total score of the Bailey Dietary Screening Questionnaire (Bailey et al., 2009), and eating behaviour in the area of uncontrolled eating, cognitive restraint and emotional eating measured from the Three Factor Eating Questionnaire or TFEQ-R18 (Cappelleri et al., 2009). Variables that measured *energy intake and expenditure* variables were from a three day Food, Drink and Exercise diary that participants completed prior to each clinic appointment. The diary included a record of physical activity (energy expenditure) and dietary intake behaviour (energy consumption), and participants self-reported belief about the accuracy of their physical activity and dietary intake log (Bouchard et al., 1983; Hattar et al., 2015; Pal & Ellis, 2010). This information was examined using the Food Works program; the specific dietary intake variable examined was energy inclusive of dietary fibre. In addition, *program compliance* variables were measured at week 6 and 12, which included self-reported items related to participants beliefs about their compliance with the program guidelines of engagement in the physical activity and dietary intake weight-loss recommendations (*see* Hattar et al., 2015).

Psychological variables. The psychological variables were measured at baseline, and week 6 and 12 unless specified otherwise. *Psychological wellbeing*

variables included quality of life using the total score of The Impact of Weight on Quality of Life Questionnaire (IWQOL - Lite), (Kolotkin et al., 2002), and symptoms of depression, anxiety, and stress using the subscale scores from the Depression Anxiety Stress Scales-21 scale (DASS-21), (Lovibond & Lovibond, 1995). In addition, *HAPA measure* items were examined. These items were adapted from Barg and colleagues (2012) and included risk perception, outcome expectancy, intention, action self-efficacy, maintenance self-efficacy, and action planning (Hattar et al., 2015). In addition, a variable of motivation was adopted from Hagger and colleagues (2012). The specified HAPA related items, were measured separately for physical activity and dietary intake, excluding the variable risk perception which was examined independently as it did not relate specifically to physical activity or dietary intake and examined perception of risk associated with obesity.

Other measures. Other measures included for preliminarily analyses are listed. *Body mass index* was measured, as one of the study inclusion criteria was that the participant's baseline body mass index is between 25 to 40 (overweight or obese); this was measured by dividing weight over height squared. At baseline only, *imagery ability* was measured using the total score from the Betts' Questionnaire upon Mental Imagery (Sheehan, 1967) to determine if mental imagery ability moderated the effectiveness of the mental imagery intervention and therefore whether it should be included as a potential covariate.

Intervention checks were also included to ensure participants engaged with the intervention activities. That is, if participant completed the goal setting activities, and for intervention condition the relevant implementation intention and mental imagery activities according to the instructions. All participants were required to list

three SMART goals each for physical activity and dietary intake. In addition, participants in the intervention condition were required to complete implementation intention and process mental imagery activities for each goal; for example, participants were asked to respectively, list their 'if-then' plans and the steps imagined during the intervention process. Intervention participants were also required to complete an outcome mental imagery activity and list the imagined steps. Participant responses were "coded" based on whether the responses were consistent with the formation of an implementation intention and appropriate visualisation of behavioural steps (*see* Appendix N for coding information). These outlined variables were measured as they were expected to mediate the interventions key components. For example, the effect of the interventions mental imagery component on the outcome variables is expected to mediate the HAPA variables of self-efficacy, motivation, outcome evaluation, and intention. Also, the effect of the interventions 'if-then' plan component on the outcome variables is expected to be mediated by the HAPA planning variable.

Intervention evaluation items were included at baseline after participants viewed the HEALTHI program. Participants were asked whether "The HEALTHI program provided me with new information that can assist me to lose weight?" Possible participant responses ranged from 1 (strongly agree) to 5 (strongly disagree). Participants were also asked "Please rate how clear you understood the provided HEALTHI Program information" with possible responses ranging from 1 (very clear) to 5 (very unclear).

Results

Power analysis and missing data. Seventy five participants completed the HEALTHI program. For the analyses, one participant's data set was removed from the study because their body mass index at baseline did not meet study inclusion criteria. Of the remaining 74 participants, four dropped out at the 6-week follow-up appointment, and three dropped out at the 12-week follow-up appointment. Missing data due to missing items was minimal as the majority of data collection was via the researcher in the clinic and the Qualtrics^{TM} online questionnaire which required mandatory completion of each item prior to submission. A full intention-to-treat analysis was conducted to account for the missing data, using the 'last observation carried forward' procedure (Streiner, 2014).

The study used 74 participant data sets for analyses which was determined adequate according to an a priori power analyses. We aimed to examine intervention effects for each set of outcome variables (biomedical, behavioural, and psychological) separately. Each set of outcome variables were conceptualised into groups, with each set of variable group examined using MANOVA analyses (*see* Appendix O for information on the conceptualisation of the outcome categories). Specifically, the G*Power 3.1.9.2 Program was used to determine the sample size based on the most complex MANOVA model (Faul et al., 2009). That is, the 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 3 (Time of measurement: baseline, week 6 and 12) MANOVAs that examined six dependent variables (with each dependent variable measured at each of the three time points) leading to a total of 18 measures.

The G*Power 3.1.9.2 Program analysis indicated that an approximate sample size of 75 participants was sufficient to evaluate differences between the three condition levels, with an 80% chance of detecting a large effect size at a .05 alpha level (Faul et al., 2009). A large effect size of f = .45 was estimated from previous studies that examined physical activity using implementation intentions, mental imagery, and/or text messages; these studies are described. One study explored implementation intentions over a control condition for physical activity for breast cancer examination (d = .74), a study identified by Gollwitzer and Sheeran (2006). Prestwich and colleges (2009) study examined physical activity, and compared a condition that formed implementation intentions paired with text messages, and a condition that formed implementation intentions without text messages (d = .59). A study by Anderson and Moss (2011) examined the difference between implementation intentions and control condition (d = .92), and a guided imagery and control condition (d = 1.46). The mean effect size calculated from these studies was large, with a Cohen's (1988) d of .92, which is equivalent to an f value of .46 (J. Cohen, 1988).

Preliminary analyses. Participant demographic data and scores on study measures are reported in Table 4.2. A one-way ANOVA (*see* Appendix P, Table P1) indicated that at baseline the three conditions did not significantly differ in age, body weight, body mass index, or mental imagery ability. The non-significant baseline mental imagery ability scores from the Betts' Questionnaire upon Mental Imagery total score indicated that this variable need not be included as a covariate in the analyses. Chi-square analysis indicated that the three conditions did not significantly differ in terms of male to female ratio (*see* Appendix P, Table P1).

Table 4.2

Participant demographic data at baseline

Variable	Condition 1 (n = 25)		Condition 2 (n = 25)		Condition 3 (n = 24)		Total (n = 74)	
Age	40.71	(12.83)	39.52	(11.65)	43.14	(11.99)	41.10	(12.10)
Weight (kg)	87.88	(14.93)	85.77	(13.36)	90.98	(14.95)	88.17	(14.24)
Body mass index	30.58	(2.61)	30.95	(3.95)	31.87	(3.94)	31.13	(3.55)
Mental imagery ability	72.88	(26.05)	66.00	(22.52)	81.67	(33.99)	73.41	(28.20)
Female	18		22		18		58	
Male	7		3		6		16	

Note. The displayed values are the means (standard deviations) for each variable, except for the gender variables (female and male) the displayed values are the number of participants. Condition 1 is the psycho-education weight-loss condition. Condition 2 is the psycho-education plus implementation intention and mental imagery condition. Condition 3 is the psycho-education plus implementation intentions and mental imagery with text messages conditions.

The intervention checks were also assessed to ensure that participants within the three conditions did not differ in the quality of responses to the goal setting and, if relevant, the implementation intentions and mental imagery activities. Participant responses to these activities were coded to ensure responses were completed in accordance to the instructions. The coding system used to determine whether participant responses were appropriate and realistic is available in Appendix N. It was important to examine whether these outlined variables differed across conditions as these variables are expected to mediate the interventions key components. Two researchers separately coded participants' responses to the open-ended questions for the goals, implementation intentions, and mental imagery exercises based on coding criteria; the coding criteria is outlined in Appendix N. An interrater reliability

analysis using the Kappa statistic was performed to determine consistency among the researchers coding. The scores allocated by each of the researchers were compared and the interrater reliability examined. Appendix P (*see* Table P2) shows the Kappa value for each variable. The high Kappa values and significant results indicated that there was high consistency among the researchers' ratings; that is, Kappa values (range: .81 to 1.00) indicated strong agreement among researchers (Landis & Koch, 1977). The average of the codes from each of the researchers was computed to provide the participant with a score for each of the goal setting, implementation intentions and mental imagery activity responses. As each participant completed a total of three goals, implementation intentions, and process mental imagery activities for both dietary intake and physical activity, an average score was computed to provide a total score for dietary intake and physical activity for goals, implementation intentions, and process mental imagery. Using this average score, a one-way ANOVA was conducted to determine whether the three conditions differed on physical activity and dietary intake goal scores. Statistically non-significant differences were found between the three conditions on goal setting as displayed in Appendix P (*see* Table P3). A one-way ANOVA was conducted to examine whether the two intervention conditions differed on the physical activity and dietary intake implementation intentions and both process and outcome mental imagery activity scores. Statistically non-significant differences were found between the three conditions as shown in Appendix P (*see* Table P4).

The program evaluation items were also assessed to ensure that participants found the HEALTHI program provided new information and that the information was clear. In response to the item "The HEALTHI program provided me with new

information that can assist me to lose weight?" Results indicated that 56.25% of participants strongly agreed with the item, 37.50% somewhat agreed, and 6.25% returned a neutral response. In response to the item "Please rate how clear you understood the provided HEALTHI Program information," 43.75% of participants rated the information very clear, 50% somewhat clear, and 6.25% provided a neutral response. These questions provide some information on participants' views of the intervention, however the items were somewhat limited as a means to assess satisfaction as they may have been biased due to the way in which the questions were phrased. Specifically, the item used terms like "clear" and "new information" which highlighted the desired response rather than phrasing the question in a neutral manner.

Statistical Analyses

Determining the analytic model. Multivariate repeated-measures design analyses can be conducted using either of two theoretical perspectives, namely the doubly multivariate approach and multivariate mixed-model perspective (Boik, 1991). The multivariate mixed-model perspective has restrictions on the repeated measurements variance-covariance matrix structure, while the doubly multivariate approach does not have these restrictions (Boik, 1991). Therefore, the current study adopted the doubly multivariate approach.

Box's Test of Equality of Covariance Matrices was used to test multi-sample sphericity, that is, whether the assumption that the covariance matrices of dependent variables in the MANOVA were equivalent across all three conditions. For some of the MANOVA analyses, the results indicated significant *F* ratio's for the

corresponding Box's *M* statistic which indicated violation of the MANOVA homogeneity of covariance assumption (*see* Appendix Q, Table Q1); these results indicated that the researchers should examine the data within the multivariate tests (B. Cohen, 2007). Further analyses examined sphericity at the individual level using Mauchly's Test of Sphericity and found significant values for the majority of the MANOVA analyses data (*see* Appendix Q, Table Q2); significant values indicated that the assumption of sphericity had been violated at the individual level (Mauchly, 1940). That is, violation of the assumption that the difference scores between each within-subject variable have similar variances (Mayer, 2013). Thus although some of the MANOVA analyses did not violate the assumption of multi-sample sphericity, violation of sphericity at the individual level led the researchers to examine the data within the multivariate tests for all the analyses. The multivariate test statistic (MANOVA) does not require the assumption of sphericity (Howell, 2009). Examining all the MANOVA data analyses using the multivariate tests also provided consistency among result interpretation. In addition, the power analyses were conducted based on this multivariate repeated measures design approach.

The doubly-multivariate approach was used to examine the current study data within the multivariate tests for each of the 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 3 (Time of measurement: baseline, week 6 and 12) mixed model multivariate analyses (MANOVAs) with time as a repeated measures variable to examine the effects of the intention over time on the intervention study outcome variables. Outcome variables were classified into biomedical, psychological and behavioural outcomes categories, with a MANOVA analyses conducted for each of the specified categories (*see* Appendix O for category

conceptualisation). When examining the multivariate tests the Wilks Lambda value was used as the dependent variables had more than two conditions (Mayer, 2013). As the Mauchley's test indicated sphericity was violated for some of the dependent variable sets, the main effects for each dependent variable were evaluated using Huynh-Feldt statistic (Mauchly, 1940). Furthermore, dependent variables that showed significant effects were further examined by conducting least significant difference (LSD) pairwise comparison across the effect to determine the source.

Assumption testing. The adopted approach required testing of multivariate normal distribution and covariance matrices equality across the three conditions. Using LISREL for windows (Joreskog & Sorbom, 2013), examination of the chi-square test output for multivariate normality indicated assumption violation with significant *p* values for the skewness and kurtosis values (*see* Appendix Q, Table Q1). However, although the dependent variable was not normally distributed within the condition, the *F* test is robust to non-normality when the cause of non-normality is from skewness as opposed to outliers (French, Macedo, Poulsen, Waterson, & Yu, 2010); this is based on the assumption that the underlying population distributions are skewed rather than normal, which implies that the non-normality in the sample distribution is due to skewness rather than outliers. For the risk perception variable, univariate normality was observed as risk perception was the only dependent variable examined across three time points; this was done through visual observation of the histograms. In addition, the test of equality of covariance matrices across the three conditions was conducted using Levene's Test of Equality of Error Variances (B. Cohen, 2007); the MANOVA analyses found that the assumption was met for the

majority of the variables at each time point, indicated by non-significant *p* values within the Levene's Test of Equality of Error Variances (*see* Appendix Q, Table Q3).

Main Analyses

Biomedical outcomes. A one-way ANOVA indicated that the participants in the three conditions did not significantly differ at baseline on the biomedical variables measures (*see* Appendix R, Table R1). A series of 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 3 (Time of measurement: baseline, week 6 and 12) mixed-model MANOVAs were conducted to examine the main and interactive effects of the intervention conditions and time of measurement on the biomedical outcome variables (with the conceptualisation of categories specified in Appendix O). For each MANOVA, the multivariate tests were initially examined using Wilks' Lambda value. Significant multivariate main effects were examined with planned univariate follow-up tests using the Huynh-Feldt value. Significant univariate tests were further examined using LSD pairwise comparisons (Table 4.3). Descriptive statistics of the biomedical variables are presented in Table 4.4.

Body composition. A 3 x 3 MANOVA identical in design to the previous analysis was conducted to examine the effects of the intervention and measurement of time on body composition variables (body weight, body fat percentage, and average waist-hip ratio). The values of each of these variables are displayed in Table 4.4; a significant decrease over time for each variable would indicate improvements in body composition. The multivariate test revealed no statistically significant main

Table 4.3

Biomedical variables pairwise comparison analysis

		Mean difference, (standard error) and significance value		
Category	Variable	Baseline to week 6	Baseline to week 12	Week 6 to 12
Body composition	Body weight (kg)	-2.64 (.32), $p < .001$	-4.21 (.52), $p < .001$	-1.57 (.26), $p < .001$
	Body fat percentage (%)	-.95 (.13), $p < .001$	-1.57 (.22), $p < .001$	-.62 (.14), $p < .001$
	Waist-hip ratio (cm)	-.01 (.002), $p < .001$	-.01 (.003), $p = .002$	-.001 (.002), $p = .643$
Blood pressure	Systolic (mmHg)	-2.15 (.79), $p = .008$	-3.94 (1.00), $p < .001$	-1.79 (.91), $p = .052$
	Diastolic (mmHg)	-3.17 (.75), $p < .001$	-4.58 (.75), $p < .001$	-1.41 (.66), $p = .034$
Blood lipoproteins	Low-density lipoprotein (mmol/L)	-.18 (.07), $p = .007$	-.13 (.06), $p = .035$	.05 (.05), $p = .302$
	Total cholesterol (mmol/L)	-.28 (.07), $p < .001$	-.23 (.07), $p = .002$	.05 (.06), $p = .390$
	Triglycerides (mmol/L)	-.10(.06), $p = .132$	-.14 (.06), $p = .024$	-.04 (.04), $p = .312$
	Glucose (mmol/L)	-.14 (.06), $p = .014$	-.18 (.07), $p = .009$	-.03 (.05), $p = .460$
	Insulin (mU/L)	-1.72 (.65), $p = .011$	-2.80 (.61), $p < .001$	-1.09 (.44), $p = .017$

Note. High-density lipoprotein was not included in this table as the univariate test indicated it was not statistically significant thus follow-up pairwise comparison analysis were not conducted.

Table 4.4

Biomedical variables descriptive statistics with mean (standard deviations) at each time point

		Baseline				Week 6				Week 12			
Variable category	Variable	Condition 1	Condition 2	Condition 3	All	Condition 1	Condition 2	Condition 3	All	Condition 1	Condition 2	Condition 3	All
Body comp-osition	Body weight	85.80 (10.31)	85.77 (13.36)	90.98 (14.95)	87.49 (13.07)	82.89 (9.58)	83.75 (12.66)	87.99 (13.56)	84.86 (12.10)	81.03 (9.80)	82.48 (12.74)	86.42 (13.38)	83.30 (12.13)
	Body fat percentage	36.56 (4.04)	37.84 (4.50)	38.19 (4.51)	37.54 (4.36)	35.36 (4.43)	37.24 (4.23)	37.13 (4.75)	36.59 (4.56)	34.60 (4.70)	36.74 (4.73)	36.55 (5.55)	35.97 (5.03)
	Waist-hip ratio	0.85 (0.06)	0.82 (0.05)	0.84 (0.09)	0.83 (0.07)	0.84 (0.06)	0.82 (0.05)	0.82 (0.09)	0.83 (0.07)	0.84 (0.06)	0.82 (0.05)	0.82 (0.09)	0.83 (0.07)
Blood pressure	Systolic	115.32 (10.64)	118.31 (12.78)	117.72 (13.83)	117.11 (12.36)	114.09 (10.63)	113.48 (11.86)	117.32 (14.52)	114.93 (12.35)	111.68 (9.04)	113.51 (12.17)	114.34 (14.22)	113.16 (11.86)
	Diastolic	80.07 (8.65)	82.07 (10.34)	83.51 (9.26)	81.86 (9.42)	76.79 (9.03)	78.61 (8.12)	80.75 (10.35)	78.69 (9.22)	75.07 (8.09)	77.89 (8.26)	78.95 (10.77)	77.28 (9.12)
	Low-density	2.89 (0.90)	3.10 (0.76)	3.11 (0.58)	3.03 (0.75)	2.72 (0.87)	2.90 (0.83)	2.94 (0.73)	2.85 (0.81)	2.84 (0.82)	2.93 (0.76)	2.94 (0.70)	2.90 (0.75)

Blood	High-	1.51	1.52	1.40	1.48	1.40	1.49	1.40	1.43	1.43	1.48	1.45	1.45
lipopr-	density	(0.40)	(0.44)	(0.29)	(0.38)	(0.33)	(0.41)	(0.30)	(0.35)	(0.32)	(0.40)	(0.31)	(0.34)
oteins	Total	5.06	5.18	5.16	5.13	4.73	4.97	4.88	4.86	4.88	4.93	4.92	4.91
	cholesterol	(1.03)	(0.87)	(0.68)	(0.85)	(1.09)	(1.07)	(0.83)	(0.99)	(0.98)	(0.94)	(0.86)	(0.91)
	Triglyce-	1.44	1.22	1.41	1.36	1.35	1.27	1.17	1.26	1.35	1.12	1.19	1.22
	rides	(1.02)	(0.71)	(0.65)	(0.79)	(1.04)	(0.68)	(0.57)	(0.78)	(0.93)	(0.65)	(0.53)	(0.72)
	Glucose	5.40	5.28	5.26	5.32	5.25	5.11	5.16	5.17	5.23	5.16	5.03	5.14
	levels	(0.92)	(0.46)	(0.67)	(0.70)	(0.74)	(0.42)	(0.51)	(0.56)	(0.76)	(0.47)	(0.42)	(0.57)
	Insulin	13.39	12.26	14.28	13.32	11.70	10.22	12.86	11.61	10.61	9.57	11.35	10.52
	levels	(9.22)	(5.63)	(9.84)	(8.38)	(8.98)	(6.72)	(9.42)	(8.42)	(8.48)	(3.95)	(8.67)	(7.32)

Note. Condition 1 is the psycho-education weight-loss condition. Condition 2 is the psycho-education plus implementation intention and mental imagery condition. Condition 3 is the psycho-education plus implementation intentions and mental imagery with text messages condition.

effect for condition, Wilks' Lambda = .914, $F(6, 136) = 1.04$, $p = .403$, partial $\eta^2 = .044$. No Condition by Time of measurement interaction was found, Wilks' Lambda = 0.915, $F(12, 130) = .49$, $p = .916$, partial $\eta^2 = .043$. However; the results did indicate statistically significant effects of time across the three conditions, Wilks' Lambda = 0.480, $F(6, 65) = 11.73$, $p < .001$, partial $\eta^2 = .520$. Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value and found a significant effect for all three body composition variables over time. The main effect of body weight was statistically significant over time, $F(1.20, 83.92) = 62.06$, $p < .001$, partial $\eta^2 = .470$. LSD pairwise comparisons revealed that weight significantly decreased from baseline to week 6 (mean difference = -2.64 kilograms, $p < .001$), baseline to week 12 (mean difference = -4.21 kilograms, $p < .001$), and week 6 to 12 (mean difference = -1.57 kilograms, $p < .001$). The main effect of body fat percentage was also statistically significant across time, $F(1.40, 98.24) = 43.94$, $p < .001$, partial $\eta^2 = .386$. LSD pairwise comparisons revealed significant decrease in body fat percentage from baseline to week 6 (mean difference = -.95%, $p < .001$), baseline to week 12 (mean difference = -1.57%, $p < .001$), and week 6 to 12 (mean difference = -.62%, $p < .001$). Although the main effect of body fat percentage decreased over time, the average scores displayed in Table 4.4 reveal that HEALTHI participants continued to be in the very high level of body fat range (female 35-50%, male 25-50% as per the category cut-off scores documented in Appendix M). The main effect of average waist-hip ratio was found to be statistically significant across time $F(1.68, 117.41) = 9.04$, $p = .001$, partial $\eta^2 = .114$. A significant decrease in waist-hip ratio was found from baseline to week 6

(mean difference = -.01 cm, $p < .001$) and baseline to week 12 (mean difference = -.01 cm, $p < .01$). However; no significant decrease in waist-hip ratio was found from week 6 to 12 ($p = .643$). The average waist-hip ratio scores on Table 4.4 show that at the baseline and follow-up time periods, the waist-hip ratio scores indicated HEALTHI program participants remained at substantially increased health risk; that is ≥ .90 cm for males or ≥ .85 cm for females (WHO, 2008).

Blood pressure. Blood pressure scores displayed in Table 4.4 indicate that the average systolic and diastolic blood pressure for all HEALTHI participants at baseline, week 6 and 12 were in the normal blood pressure score ranges of less than 120/80 mmHg (systolic/diastolic). A 3 x 3 MANOVA identical in design to the previous analysis was conducted to examine the effects of the intervention conditions and time of measurement on blood pressure measures. The multivariate test revealed no statistically significant main effect for condition, Wilks' Lambda = .959, $F(4, 140) = .73$, $p = .572$, partial $\eta^2 = .020$. In addition, no main Condition by Time interaction was found, Wilks' Lambda = 0.894, $F(8, 136) = .98$, $p = .451$, partial $\eta^2 = .055$. However; the results indicated statistically significant effects of time across the three conditions, Wilks' Lambda = .645, $F(4, 68) = 9.35$, $p < .001$, partial $\eta^2 = .355$. Univariate planned follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value and found a significant effect for the main effects of both systolic and diastolic blood pressure variables. The main effect of systolic blood pressure was statistically significant over time, $F(1.97, 139.62) = 9.61$, $p < .001$, partial $\eta^2 = .119$. LSD pairwise comparisons revealed that systolic blood pressure statistically significantly decreased from baseline to week 6 (mean

difference = -2.15 mmHg, $p < .01$) and baseline to week 12 (mean difference = -3.94 mmHg, $p < .001$); however no statistically significant difference was found from week 6 to 12 ($p = .052$). The main effect of diastolic blood pressure was also found to be statistically significant over time, $F(2, 142) = 21.30$, $p < .001$, partial $\eta^2 = .231$. LSD pairwise comparisons revealed that diastolic blood pressure significantly decreased from baseline to week 6 (mean difference = 3.17 mmHg, $p < .001$), baseline to week 12 (mean difference = -4.58 mmHg, $p < .001$), and week 6 to 12 (mean difference = -1.41 mmHg, $p < .05$).

Blood lipoproteins. The blood lipoprotein scores displayed in Table 4.4 suggest that all the HEALTHI participants over the three time periods had acceptable blood lipoprotein levels for low-density lipoprotein (LDL) (<3.5 mmol/L), high-density lipoprotein (HDL) (>1.0 mmol/L), total cholesterol (TC) (<5.5 mmol/L), triglycerides (<1.5 mmol/L), and fasting glucose (between 2.5 - 5.4 mmol/L). As outlined in Table 4.4, all HEALTHI participants fasting insulin levels were above the ideal value of <12 mU/L at baseline, however were within this suggested range at the follow-up periods of week 6 and 12. A 3 x 3 MANOVA identical in design to the previous analysis was conducted to examine the effects of the intervention conditions and time of measurement on blood lipoprotein measurements. The multivariate test revealed no statistically significant main effect for condition, Wilks' Lambda = .899, $F(12, 124) = .56$, $p = .868$, partial $\eta^2 = .052$. No main Condition by Time interaction was found, Wilks' Lambda = .654, $F(24, 112) = 1.11$, $p = .350$, partial $\eta^2 = .192$. However; the results indicated statistically significant effects of time across the three conditions, Wilks' Lambda = .526, $F(12, 56) = 4.21$, $p < .001$, partial $\eta^2 = .474$.

Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value and found a significant effect for all the lipoprotein variables over time except for HDL. The main effect of HDL was statistically non-significant over time, $F(2, 134) = 2.16$, $p = .119$, partial $\eta^2 = .031$. The main effect of LDL was statistically significant over time, $F(1.94, 129.65) = 5.02$, $p < .01$, partial $\eta^2 = .070$. LSD pairwise comparisons revealed that LDL levels significantly decreased from baseline to week 6 (mean difference = -.18 mmol/L, $p < .01$) and baseline to week 12 (mean difference = -.13 mmol/L, $p < .05$). No statistically significant difference was found for the effect of LDL levels from week 6 to 12 ($p = .302$). The main effect of TC was statistically significant over time, $F(2, 134) = 9.86$, $p < .001$, partial $\eta^2 = .128$. LSD pairwise comparisons revealed that TC levels significantly decreased from baseline to week 6 (mean difference = -.28 mmol/L, $p < .001$) and baseline to week 12 (mean difference = -.23 mmol/L, $p < .01$). No statistical difference was found for TC levels from week 6 to 12 ($p = .390$). The main effect of triglyceride levels was statistically significant over time, $F(1.75, 117.14) = 3.25$, $p < .05$, partial $\eta^2 = .046$. LSD pairwise comparisons revealed that triglyceride levels significantly decreased from baseline to week 12 (mean difference = -.14 mmol/L, $p < .05$). However; no statistical difference was found for triglyceride levels from baseline to week 6 ($p = .132$), and week 6 to 12 ($p = .312$). The main effect of glucose levels was statistically significant over time, $F(1.82, 121.89) = 5.49$, $p < .01$, partial $\eta^2 = .076$. LSD pairwise comparisons revealed glucose levels significantly decreased from baseline to week 6 (mean difference = -.14 mmol/L, $p < .05$) and baseline to week 12 (mean difference = -.18 mmol/L, $p < .01$). However; no

statistical difference was found for the effect of glucose levels from week 6 to 12 (p = .460). The main effect of insulin levels was statistically significant over time, $F(1.80, 120.33) = 12.08$, $p < .001$, partial $\eta^2 = .153$. Insulin levels significantly decreased from baseline to week 6 (mean difference = -1.72 mU/L, $p < .05$), baseline to week 12 (mean difference = -2.80 mU/L, $p < .001$), and week 6 to 12 (mean difference = -1.09 mU/L, $p < .05$).

Psychological outcomes. A one way ANOVA indicated that the three conditions did not significantly differ at baseline on the psychological variables examined (*see* Appendix R, Table R2) except for the dietary intake planning variable. Dietary intake planning scores at baseline were found to significantly differ among the three conditions, $F(2, 71) = 3.35$, $p < .05$; specifically the LSD multiple comparison results revealed the statistically significant effect was between the psycho-education plus implementation intentions and mental imagery condition, and the psycho-education plus implementation intentions and mental imagery with text messages condition, (mean difference = -.945, $p < .05$). As MANOVA analyses were conducted it was not feasible to introduce baseline pre-test dietary intake planning scores as a covariate as the measure of planning was an outcome variable, and if this was done then it would lead to the need to include all the baseline pre-test outcome variables as covariates. However; to account for dietary intake planning scores significantly differing at baseline for the three conditions, a correlation analysis was conducted with this variable and each of the psychological outcome variables at week 12 (*see* Table 4.5). A significant correlation with baseline planning scores was found for only six of the variables including: physical activity action self-efficacy,

intentions, and outcome expectancies; dietary intake planning, action self-efficacy, and intentions. These results indicated that the effects involving these outcomes may potentially be affected by between-condition differences in baseline dietary intake planning values and this will be examined further in the relevant results section.

Table 4.5

Baseline dietary planning variable correlations with other psychological variables

Category	Variable at week 12	Correlation
Psychological	Impact of weight on quality of life	.171
wellbeing	Depression symptoms	.029
	Anxiety symptoms	.184
	Stress symptoms	.014
Physical activity	Action self-efficacy	.264*
HAPA	Outcome expectancy	.365**
	Maintenance self-efficacy	.150
	Intention	.242*
	Planning	.215
	Motivation	.109
Dietary intake	Action self-efficacy	.282*
HAPA	Outcome expectancy	.182
	Maintenance self-efficacy	.164
	Intention	.245*
	Planning	.333**
	Motivation	.210
Risk perception	Risk perception	.076

Note. p *<.05. **<.01.

Four MANOVAs were conducted to examine the effects of the intervention on the psychological outcome variables (as per the conceptualisation categories specified in Appendix O). Each MANOVA analysis was interpreted using the multivariate tests examined using Wilks' Lambda. Statistically significant main effects were examined using planned univariate follow-up tests with the Huynh-Feldt value. Further examinations of statistically significant effects were conducted using univariate LSD pairwise comparisons (*see* Table 4.6). Descriptive statistics for the psychological outcome variables at each time point are available in Table 4.7.

Psychological wellbeing. The psychological wellbeing variables of impact of weight on quality of life, and symptoms of depression, anxiety and stress were examined. A 3 x 3 MANOVA identical in design to the previous analysis was conducted to examine the main effects of the intervention conditions and time of measurement on the psychological wellbeing variables. Multivariate test revealed no statistically significant main effect for condition, Wilks' Lambda = .884, $F(8, 136) = 1.08$, $p = .380$, partial $\eta^2 = .060$. No main Condition by Time interaction was found, Wilks' Lambda = .740, $F(16, 128) = 1.30$, $p = .208$, partial $\eta^2 = .140$. However; the results indicated statistically significant effects of time across the three conditions, Wilks' Lambda = .516, $F(8, 64) = 7.51$, $p < .001$, partial $\eta^2 = .484$. Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value and found that over time there was a statistically significant effect for the variables of impact of weight on quality of life and symptoms of depression. The main effect of impact of weight on quality of life was

Table 4.6

Psychological variables pairwise comparisons

Category	Variable	Mean difference, (standard error) and significance value		
		Baseline to week 6	Baseline to week 12	Week 6 to 12
Psychological	Impact of weight on quality of life	-6.32 (1.16), $p < .001$	-11.25 (1.58), $p < .001$	-4.93 (1.06), $p < .001$
wellbeing	Depression symptoms	-2.13 (.78), $p = .008$	-2.54 (.96), $p = .010$	-.41 (.51), $p = .425$
Physical activity	Maintenance self-efficacy	-1.55 (.88), $p = .080$	-2.30 (1.08), $p = .037$	-.75 (.77), $p = .336$
HAPA	Intention	-.53 (.17), $p = .002$	-.80 (.22), $p < .001$	-.27 (.19), $p = .153$
	Planning	.67 (.16), $p < .001$	.47 (.17), $p = .006$	-.20 (.11), $p = .057$
	Motivation	-.55 (.34), $p = .110$	-1.32 (.38), $p = .001$	-.77 (.28), $p = .007$
Dietary intake	Action self-efficacy	-.04 (.46), $p = .926$	-1.20 (.56), $p = .036$	-1.16 (.43), $p = .009$
HAPA	Intention	-.50 (.14), $p = .001$	-.91 (.22), $p < .001$	-.41 (.18), $p = .028$
	Planning	1.01 (.16), $p < .001$	.68 (.17), $p < .001$	-.33 (.12), $p = .008$
	Motivation	-.98 (.30), $p = .002$	-2.13 (.40), $p < .001$	-1.15 (.28), $p < .001$
Risk perception	Risk perception	-1.40 (.37), $p < .001$	-1.65 (.39), $p < .001$	-.25 (.28), $p = .373$

Note. Anxiety and stress symptoms (from psychological wellbeing MANOVA), action self-efficacy and outcome expectancies (from physical activity HAPA MANOVA), outcome expectancies and maintenance self-efficacy (from dietary intake HAPA MANOVA) were not included in this table as the univariate test indicated it was not statistically significant thus follow-up pairwise comparison analysis were not conducted.

Table 4.7

Psychological variables descriptive statistics with mean (standard deviations) at each time point

Category	Variable	Baseline				Week 6				Week 12			
		Condition 1	Condition 2	Condition 3	All	Condition 1	Condition 2	Condition 3	All	Condition 1	Condition 2	Condition 3	All
Psych-	Impact of weight	65.00	63.96	67.29	65.39	57.68	59.52	60.08	59.08	53.60	55.68	53.21	54.18
ologi-	on quality of life	(18.88)	(18.27)	(19.91)	(18.81)	(20.62)	(22.10)	(16.86)	(19.78)	(25.93)	(18.53)	(16.18)	(20.44)
cal	Depression	7.28	5.92	8.83	7.32	5.36	5.28	5.00	5.22	4.88	5.04	4.50	4.81
well-	symptoms	(7.32)	(6.52)	(9.02)	(7.66)	(6.55)	(7.77)	(4.79)	(6.42)	(6.74)	(7.44)	(5.51)	(6.54)
being	Anxiety	3.12	3.92	5.92	4.30	3.20	3.44	2.67	3.11	3.04	2.88	4.08	3.32
	symptoms	(3.06)	(4.92)	(7.92)	(5.67)	(6.08)	(3.68)	(3.52)	(4.54)	(6.22)	(3.75)	(7.11)	(5.79)
	Stress	9.20	7.84	12.33	9.76	8.56	6.72	10.25	8.49	7.92	6.88	11.67	8.78
	Symptoms	(5.26)	(6.97)	(9.65)	(7.61)	(7.63)	(7.59)	(6.78)	(7.39)	(7.47)	(7.10)	(7.86)	(7.66)
Phys-	Action self-	18.88	19.00	18.96	18.95	18.68	18.20	18.67	18.51	19.12	17.52	19.13	18.58
ical	efficacy	(3.97)	(4.12)	(3.50)	(3.83)	(4.72)	(4.56)	(4.64)	(4.59)	(4.62)	(5.32)	(4.67)	(4.87)
activ-	Outcome	13.48	13.96	13.67	13.70	13.48	14.16	13.67	13.77	13.52	14.28	13.21	13.68
ity	expectancy	(1.30)	(1.06)	(1.49)	(1.29)	(2.00)	(1.34)	(1.47)	(1.64)	(1.69)	(1.28)	(1.77)	(1.63)
HAPA	Maintenance	33.28	33.24	34.25	33.58	31.52	31.92	32.67	32.03	31.88	29.48	32.50	31.27
	self-efficacy	(7.50)	(7.73)	(7.24)	(7.41)	(9.33)	(8.98)	(8.85)	(8.95)	(9.51)	(11.64)	(9.59)	(10.24)
	Intention	9.20	9.44	9.33	9.32	8.56	8.92	8.92	8.80	8.60	8.36	8.63	8.53
		(.91)	(1.00)	(1.31)	(1.07)	(1.36)	(1.29)	(1.67)	(1.43)	(1.61)	(2.06)	(1.72)	(1.78)

	Action planning	3.08	3.52	2.75	3.12	3.40	3.80	4.17	3.78	3.20	3.64	3.92	3.58
		(1.35)	(1.33)	(1.39)	(1.37)	(1.16)	(1.16)	(1.01)	(1.14)	(1.26)	(1.38)	(1.10)	(1.27)
	Motivation	14.68	15.48	14.92	15.03	14.20	14.44	14.79	14.47	14.60	12.52	14.00	13.70
		(2.43)	(2.35)	(2.28)	(2.35)	(2.65)	(3.27)	(2.84)	(2.90)	(2.83)	(3.63)	(3.51)	(3.41)
Diet-	Action self-	19.24	19.08	19.50	19.27	19.32	18.08	20.29	19.22	19.44	17.28	17.50	18.08
ary	efficacy	(2.85)	(4.34)	(4.01)	(3.75)	(3.68)	(5.08)	(4.36)	(4.45)	(3.33)	(4.89)	(5.79)	(4.80)
intake	Outcome	13.36	14.08	13.92	13.78	13.60	14.08	14.37	14.01	13.68	14.08	14.04	13.93
HAPA	expectancy	(2.00)	(1.63)	(1.72)	(1.79)	(2.06)	(1.44)	(1.25)	(1.63)	(1.82)	(1.61)	(1.33)	(1.59)
	Maintenance	36.28	33.32	35.25	34.95	35.92	33.24	37.33	35.47	36.04	30.64	33.33	33.34
	self-efficacy	(5.04)	(8.16)	(7.24)	(6.95)	(7.09)	(8.76)	(7.17)	(7.80)	(6.97)	(10.43)	(10.09)	(9.42)
	Intention	9.20	9.48	9.38	9.35	8.76	8.76	9.04	8.85	8.56	8.44	8.33	8.45
		(1.08)	(1.05)	(.97)	(1.03)	(1.09)	(1.27)	(1.63)	(1.33)	(1.33)	(1.83)	(2.33)	(1.84)
	Action planning	2.76	3.32	2.38	2.82	3.48	3.84	4.17	3.82	3.20	3.64	3.67	3.50
		(1.36)	(1.18)	(1.31)	(1.33)	(1.09)	(1.07)	(1.09)	(1.10)	(1.16)	(1.35)	(1.34)	(1.29)
	Motivation	15.08	15.32	15.42	15.27	14.08	13.96	14.83	14.28	14.04	12.60	12.79	13.15
		(1.85)	(2.46)	(2.48)	(2.25)	(2.87)	(3.05)	(2.73)	(2.87)	(2.98)	(3.44)	(3.95)	(3.48)
Other	Risk perception	14.40	14.96	13.54	14.31	12.28	14.04	12.38	12.91	11.52	13.92	12.50	12.65
HAPA		(3.49)	(4.00)	(4.35)	(3.95)	(4.05)	(5.18)	(3.74)	(4.39)	(4.99)	(5.57)	(3.59)	(4.84)

Note. Condition 1 is the psycho-education weight-loss condition. Condition 2 is the psycho-education plus implementation intention and mental imagery condition. Condition 3 is the psycho-education plus implementation intentions and mental imagery with text messages condition.

found to be statistically significant over time, $F(1.65, 117.23) = 38.43$, $p < .001$, partial $\eta^2 = .351$. LSD pairwise comparisons revealed that impact of weight on quality of life scores significantly decreased from baseline to week 6 (mean difference = -6.32, $p < .001$), baseline to week 12 (mean difference = -11.25, $p < .001$), and week 6 to 12 (mean difference = -4.93, $p < .001$). A decrease in impact of weight on quality of life scores indicates that over time participants believed their weight had less impact on their quality of life, indicating positive improvement (Kolotkin & Crosby, 2002). The main effect of symptoms of depression were statistically significant over time, $F(1.48, 104.98) = 6.30$, $p < .01$, partial $\eta^2 = .081$. LSD pairwise comparisons revealed that symptoms of depression significantly decreased from baseline to week 6 (mean difference = -2.13, $p < .01$) and baseline to week 12 (mean difference = -2.54, $p = .01$) suggesting that participants self-reported symptoms of depression were significantly lower relative to baseline. However; no statistically significant change was found from week 6 to 12 ($p = .425$). The univariate follow-up tests revealed that the main effect of time for both symptoms of anxiety and stress were statistically non-significant, respectively $F(1.52, 107.73) = 1.81$, $p = .177$, partial $\eta^2 = .025$, and $F(1.68, 118.94) = 1.55$, $p = .219$, partial $\eta^2 = .021$. That is, participant scores indicated that their anxiety and stress levels remained consistent over time. The symptoms of depression, anxiety, and stress score values displayed in Table 4.7 reveal that HEALTHI participants were in the normal range for symptom presentation at all three time points (Lovibond & Lovibond, 1995).

HAPA physical activity variables. Preliminary analyses indicated baseline dietary intake planning scores significantly differed across conditions, and a correlation analyses indicated that the baseline dietary intake planning variable

significantly correlated with the week 12 HAPA physical activity variables of action self-efficacy, intention, and outcome expectancies. Univariate analyses were conducted to measure whether the effects involving these study outcomes were affected by between condition differences in baseline dietary intake planning values. That is, a 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 3 (Time of measurements: baseline, week 6 and 12) ANCOVA analyses was conducted for these HAPA physical activity variables with baseline dietary intake planning as a covariate (*see* Table 4.8). In addition, MANOVA analyses were conducted to examine the HAPA physical activity variables without the inclusion of a covariate (*see* Table 4.8). Results indicated that the inclusion of the covariate revealed that the main effect for time on intentions was not statistically significant with the inclusion of the covariate (*see* Table 4.8). Table 4.8 also illustrates that the significant differences in baseline dietary planning among the conditions did not affect the results for the physical action self-efficacy and outcome expectancy variables.

Table 4.8

Physical Activity HAPA variables analyses with and without baseline dietary intake as a covariate

Variable at week 12	Analysis without the covariate	Analysis with the covariate
Action self-efficacy	$F(1.87, 132.82) = .48$, $p = .605$	$F(1.90, 132.83) = .12$, $p = .882$
Intention	$F(1.93, 137.27) = 8.99$, $p < .001$	$F(1.96, 136.93) = 2.69$, $p = .072$
Outcome expectancy	$F(2, 142) = .159$, $p = .853$	$F(2, 140) = .84$, $p = .436$

The effects of the HAPA physical activity variables of action self-efficacy, maintenance self-efficacy, outcome expectancies, intention, planning and motivation were examined using a 3 x 3 MANOVA of the same design outlined previously. Descriptive statistics for each of these variables are displayed in Table 4.7. It is ideal that each of the variable scores increase over time as this would indicate that there has been improvement in self-efficacy, outcome expectancies, intentions, planning and motivation. The assessment score ranges are available in Appendix M.

The multivariate test revealed that there was no statistically significant main effect for condition, Wilks' Lambda = .804, $F(12, 132) = 1.27$, $p = .246$, partial $\eta^2 = .103$. No main Condition by Time interaction was found, Wilks' Lambda = .599, $F(24, 120) = 1.46$, $p = .094$, partial $\eta^2 = .226$. However; the results indicated statistically significant effects of time across the three conditions, Wilks' Lambda = .520, $F(12, 60) = 4.61$, $p < .001$, partial $\eta^2 = .480$. Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value. The main effect of action self-efficacy and outcome expectancies were found to be statistically non-significant over time, respectively $F(1.87, 132.82) = .48$, $p = .605$, with partial $\eta^2 = .007$, and $F(2, 142) = .16$, $p = .853$, partial $\eta^2 = .002$. This means that participants' scores on physical activity action self-efficacy and outcome expectancies levels remained consistent over time which is acceptable given baseline values were high to begin with when participants commenced the program (*see* Table 4.7; with possible score ranges from 5 to 25, and 3 to 15, for action self-efficacy and outcome expectancies respectively. The main effect of maintenance self-efficacy was statistically significant over time, $F(1.81, 128.36) = 3.27$, $p = .046$, partial $\eta^2 = .044$. LSD pairwise comparisons revealed that contrary to predictions maintenance self-

efficacy scores significantly decreased from baseline to week 12 (mean difference = -2.30, $p < .05$). In addition, no statistically significant changes occurred from baseline to week 6 ($p = .080$), and week 6 to 12 ($p = .336$). Despite the significant decrease in scores from baseline to week 12, the maintenance self-efficacy scores for HEALTHI participants was still in the ideal range at all three time points (see scores in Table 4.7; possible variable score range from 9 to 45). The main effect of intention was found to be statistically significant over time, $F(1.93, 137.27) = 8.99$, $p < .001$, partial $\eta^2 = .112$, however after conducting an ANCOVA controlling for baseline dietary intake planning no main effect was found, $F(1.96, 136.93) = 2.69$, $p = .072$, partial $\eta^2 = .037$. Contrary to predictions, the LSD pairwise comparisons revealed there was a statistically significant decrease in intention scores from baseline to week 6 (mean difference = -.53, $p < .01$), and baseline to week 12 (mean difference = -.80, $p = .000$). Despite the decrease in scores in intentions, the descriptive statistics in Table 4.7 revealed that the HEALTHI participant scores were in the high range for each of the three time points (with possible score range from 2 to 10). There were no significant changes in intention scores from week 6 to 12 ($p = .153$). The main effect of planning was statistically significant over time, $F(1.69, 119.73) = 10.99$, $p < .001$, partial $\eta^2 = .134$. As expected, the LSD pairwise comparisons revealed a significant increase in planning scores from baseline to week 6 (mean difference = .67, $p < .001$), and baseline to week 12 (mean difference = .47, $p < .01$). There were no significant changes from week 6 to 12 ($p = .057$). Descriptive statistics in Table 4.7 revealed that at all three time points the planning scores were in the neutral range (with possible score range from 1 to 5). The main effect of motivation was statistically significant over time, $F(1.89, 133.98) = 7.94$, $p = .001$, partial $\eta^2 = .101$.

LSD pairwise comparisons revealed there were no statistically significant changes in motivation levels from baseline to week 6 (p = .110). However; contrary to predictions a statistically significant decrease in motivation scores were found from baseline to week 12 (mean difference = -1.32, p = .001), and week 6 to 12 (mean difference = -.77, p < .01). The descriptive statistics in Table 4.7 revealed that at all three time points, participants' motivation scores still indicated high levels of motivation (with possible score range from 3 to 18).

HAPA dietary intake variables. Preliminary analyses indicated baseline dietary intake planning scores significantly differed across the three conditions, and correlation analyses indicated that the baseline dietary intake planning variable significantly correlated with the week 12 HAPA dietary intake variables of action self-efficacy, intention, and planning. Univariate analyses were conducted to measure whether the effects involving these outcomes were affected by the between condition differences in baseline dietary intake planning values. That is, a 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 3 (Time of measurement: baseline, week 6 and 12) ANCOVA analyses was conducted for action self-efficacy and intentions with the baseline dietary intake planning as the covariate (*see* Table 4.9). In addition, a 3 (Conditions: psycho-education weight-loss, intervention, and intervention with text message) x 2 (Time of measurement: week 6 and 12) ANCOVA analyses was conducted for planning with the baseline dietary intake planning variable as the covariate (*see* Table 4.9). In addition, MANOVA analyses were conducted to examine the HAPA dietary intake variables without the inclusion of a covariate (*see* Table 4.9). Results indicated that the inclusion of the covariate revealed that the main effect of time on dietary intake

action self-efficacy and planning were not statistically significant with the inclusion of the covariate (*see* Table 4.9). Table 4.9 also displays that the significant differences in baseline dietary intake planning among the conditions did not affect the results for the HAPA dietary intake intention variable.

Table 4.9

Dietary Intake HAPA variables analyses with and without baseline dietary intake as a covariate

Variable at week 12	*F* statistic without covariate	*F* statistic with the covariate
Action self-efficacy	$F(1.89, 134.32) = 3.91$, $p = .024$	$F(1.92, 134.35)=1.61$, $p = .206$
Intention	$F(1.66, 117.96) = 12.21$, $p < .001$	$F(1.69, 118.20) = 5.00$, $p = .012$
Planning	$F(1.83, 129.99) = 23.49$, $p < .001$	$F(1, 70) = 2.41$, $p = .125$

The intervention effects of the HAPA dietary intake variables of action self-efficacy, maintenance self-efficacy, outcome expectancies, intention, planning and motivation were examined using a 3 x 3 MANOVA of the same design outlined previously. Descriptive statistics for each of these variables are displayed in Table 4.7. Significant increase in each of the variable scores over time would be ideal as this would indicate improvement in self-efficacy, outcome expectancies, intentions, planning and motivation. Information on the score range criteria for each variable is available in Appendix M. The multivariate test revealed no statistically significant main effect for condition, Wilks' Lambda = .795, $F(12, 132) = 1.34$, $p = .204$, partial $\eta^2 = .109$. No main Condition by Time interaction was found, Wilks' Lambda = .680, $F(24, 120) = 1.06$, $p = .395$ with partial $\eta^2 = .175$. However; the results did indicate

statistically significant effects of time across the three conditions, Wilks' Lambda = .365, $F(12, 60) = 8.680$, $p < .001$, partial $\eta^2 = .635$. Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value. The main effect of action self-efficacy was found to be statistically significant over time, $F(1.89, 134.32) = 3.91$, $p = .024$, partial $\eta^2 = .052$, however after conducting the ANCOVA controlling for baseline dietary intake planning no main time effect was found, $F(1.92, 134.35) = 1.61$, $p = .206$, partial $\eta^2 = .022$. The main effect of outcome expectancies and maintenance self-efficacy were found to be statistically non-significant over time, respectively $F(1.87, 132.46) = .85$, $p = .423$, partial $\eta^2 = .012$, and $F(1.61, 114.50) = 2.81$, $p = .076$, partial $\eta^2 = .038$. Although participant's scores on these variables remained consistent over time this is acceptable given the baseline values were in the higher range to begin with when participants commenced the program; the mean scores are displayed in Table 4.7 (with possible score ranges from 3 to 15, and 9 to 45, for outcome expectancies and maintenance self-efficacy respectively. Intention scores were statistically significant over time, $F(1.66, 117.96) = 12.21$, $p < .001$, partial $\eta^2 = .147$. LSD pairwise comparisons revealed that contrary to predictions, intention scores significantly decreased from baseline to week 6 (mean difference = -.50, $p = .001$), baseline to week 12 (mean difference = -.91, $p < .001$), and week 6 to 12 (mean difference = -.41, $p < .05$). It is important to note that despite the decrease in intention scores participants did remain in the high range for intentions over all three time periods (mean scores displayed in Table 4.7; possible score range 2 to 10). The main effect of planning was found to be statistically significant over time, $F(1.83, 129.99) = 23.49$, $p < .001$, partial $\eta^2 = .249$, however after conducting the ANCOVA

controlling for baseline dietary intake planning no main time effect was found, $F(1, 70) = 2.41$, $p = .125$, partial $\eta^2 = .033$. The main effect of motivation was statistically significant over time, $F(1.71, 121.56) = 20.45$, $p < .001$, partial $\eta^2 = .224$. LSD pairwise comparisons revealed that contrary to predictions, motivation scores significantly decreased from baseline to week 6 (mean difference = -.98, $p < .01$), baseline to week 12 (mean difference = -2.13, $p < .001$), and week 6 to 12 (mean difference = -1.15, $p < .001$). The descriptive statistics as shown in Table 4.7 indicated that motivation scores remained in the higher range at the three time points (with possible score range from 3 to 18).

Risk perception. Table 4.7 shows the scores for risk perception at each of the three time points. Significant increase in risk perception over time would be ideal as it would suggest that participants have increased perceived perception of the risk associated with obesity. A 3 x 3 MANOVA identical in design to the previous analysis was conducted to examine the main effects of the intervention conditions and time of measurement on the risk perception variable. The multivariate test revealed that there was no statistically significant main effect for condition, $F(2, 71) = 1.21$, $p = .306$, partial $\eta^2 = .033$. The multivariate test revealed no significant main Condition by Time interaction, Wilks' Lambda = .930, $F(4, 140) = 1.29$, $p = .277$, partial $\eta^2 = .035$. The results did reveal statistically significant effects of time across the three conditions, Wilks' Lambda = .787, $F(2, 70) = 9.46$, $p < .001$, partial $\eta^2 = .213$. Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value and found that over time there was a significant effect for risk perception, $F(1.86, 132.28) = 13.01$, $p < .001$, partial $\eta^2 = .155$. LSD pairwise comparisons indicated significant decrease in risk perception

scores from baseline to week 6 (mean difference = -1.40, $p < .001$), and baseline to week 12 (mean difference = -1.65, $p < .001$) which contrary to predictions suggests that over time participants perception of risk decreased. No significant difference in risk perception scores were found from week 6 to 12 ($p = .373$).

Behavioural outcomes. The results of a one way ANOVA indicated that the three conditions did not differ at baseline in regards to the behavioural outcomes (*see* Appendix R, Table R3). Three MANOVAs were conducted to examine the effect of the intervention on the behavioural outcome variables (consistent with the conceptualisation categories specified in Appendix O). Each MANOVA analyses was interpreted using the multivariate tests and Wilks' Lambda value. Significant main effects were examined using planned univariate follow-up tests with the Huynh-Feldt value. Examination of significant univariate tests were conducted using LSD pairwise comparisons (*see* Table 4.10). Descriptive statistics of the behavioural variables are presented in Table 4.11.

Nutrition and eating behaviour. The intervention effects for the nutrition and eating behaviour variables of nutritional risk, uncontrolled eating, cognitive restraint and emotional eating were examined. The descriptive statistics for each variable is displayed in Table 4.11. Over time, higher scores for nutritional risk and cognitive restraint indicate improvement, whereas lower scores for uncontrolled eating and emotional eating suggest progress (Bailey et al., 2009) . A 3 x 3 MANOVA identical in design to previous analysis was conducted to examine the effects of the intervention on the nutrition and eating behaviour variables. The multivariate test revealed no statistically significant main effect for condition, Wilks' Lambda = .879, $F(8, 136) = 1.13$, $p = .345$ with partial $\eta^2 = .062$. No main Condition by Time

Table 4.10

Behavioural variables pairwise comparisons

		Mean difference, (standard error) and significance value		
Category	Variable	Baseline to week 6	Baseline to week 12	Week 6 to 12
Nutrition and eating behaviour	Nutritional risk	4.69 (1.08), $p < .001$	4.89 (1.04), $p < .001$	.20 (.62), $p = .747$
	Uncontrolled eating	-.93 (.47), $p = .051$	-1.83 (.52), $p = .001$	-.90 (.36), $p = .015$
	Cognitive restraint	1.10 (.19), $p < .001$	1.43 (.21), $p < .001$	.33 (.20), $p = .104$
	Emotional eating	-.73 (.41), $p = .078$	-.93 (.42), $p = .029$	-.21 (.35), $p = .552$
Energy intake and expenditure	Physical expenditure	135.57 (210.49), $p = .522$	-1194.53 (83.65), $p < .001$	-1330.10 (139.96), $p < .001$
Program compliance	Dietary compliance	-	-	-1.30 (.40), $p = .002$

Note. Dietary energy intake, and physical activity and dietary intake self-reported accuracy of diary input (from the energy intake and expenditure MANOVA) and physical activity compliance (from the program compliance MANOVA) were not included in this table as the univariate test indicated that these variables were not statistically significant thus follow-up pairwise comparison analysis were not conducted.

Table 4.11

Behavioural variables descriptive statistics with mean (standard deviations) at each time point

Category	Variable	Baseline				Week 6				Week 12			
		Condition 1	Condition 2	Condition 3	All	Condition 1	Condition 2	Condition 3	All	Condition 1	Condition 2	Condition 3	All
Nutrition and eating behaviour	Nutritional risk	61.24 (8.96)	60.52 (12.57)	59.87 (11.12)	60.55 (10.84)	65.56 (10.15)	65.64 (13.47)	64.50 (10.27)	65.24 (11.27)	65.84 (10.89)	65.00 (14.03)	65.46 (10.17)	65.43 (11.68)
	Uncontrolled eating	20.88 (4.27)	23.00 (6.01)	23.42 (3.72)	22.42 (4.84)	20.72 (6.37)	22.00 (7.20)	21.79 (4.62)	21.50 (6.12)	18.92 (5.75)	21.48 (7.35)	21.42 (4.79)	20.59 (6.11)
	Cognitive restraint	5.84 (1.70)	6.48 (1.74)	6.58 (1.47)	6.30 (1.65)	7.28 (2.26)	7.56 (1.50)	7.38 (1.53)	7.41 (1.78)	7.56 (2.06)	7.56 (1.76)	8.08 (2.04)	7.73 (1.95)
	Emotional eating	14.08 (4.95)	14.56 (4.81)	16.92 (4.58)	15.16 (4.88)	14.32 (5.68)	13.52 (4.61)	15.54 (4.27)	14.45 (4.91)	12.96 (5.16)	13.88 (5.68)	15.92 (4.39)	14.23 (5.19)
Energy intake and expenditure	Physical expenditure	3573.74 (678.39)	3927.44 (880.86)	3926.82 (736.83)	3809.34 (778.36)	4137.19 (2810.80)	3907.21 (872.74)	3790.30 (662.19)	3946.76 (1720.95)	2583.04 (997.34)	2656.60 (562.06)	2635.77 (492.59)	2614.64 (709.05)
	Dietary intake	14048.54 (14710.78)	15177.21 (20445.32)	9703.82 (3326.33)	13063.40 (14843.82)	9518.71 (10911.89)	20185.71 (34558.56)	7327.11 (2911.68)	12547.95 (21866.11)	19216.45 (26627.33)	9800.82 (12650.37)	14810.93 (23018.32)	14529.87 (21463.70)
	Physical accuracy	92.06 (5.11)	88.26 (11.80)	90.25 (14.35)	90.16 (11.01)	89.13 (6.82)	90.91 (10.90)	90.58 (11.33)	90.21 (9.76)	89.84 (9.51)	90.30 (10.28)	83.67 (21.00)	80.04 (14.46)
	Dietary accuracy	92.22 (9.27)	87.88 (9.36)	90.50 (10.35)	90.16 (9.67)	91.75 (8.67)	89.77 (12.66)	90.58 (9.51)	90.69 (10.34)	94.13 (7.88)	88.94 (12.19)	86.50 (17.55)	89.89 (13.22)
Program compliance	Physical compliance	-	-	-	-	7.48 (1.95)	7.50 (1.85)	7.73 (1.61)	7.57 (1.79)	7.35 (2.08)	7.14 (2.17)	7.36 (2.08)	7.28 (2.08)
	Dietary compliance	-	-	-	-	11.13 (2.75)	10.82 (3.06)	10.64 (2.44)	10.87 (2.73)	9.65 (2.82)	9.73 (3.10)	9.32 (2.71)	9.57 (2.85)

Note. Condition 1 is the psycho-education weight-loss condition. Condition 2 is the psycho-education plus implementation intention and mental imagery condition. Condition 3 is the psycho-education plus implementation intentions and mental imagery with text messages condition.

interaction was found, Wilks' Lambda = .840, $F(16, 128) = .73$, $p = .761$, partial $\eta^2 = .083$. However; a statistically significant main effect for time was found with Wilks' Lambda = .480, $F(8, 64) = 8.67$, $p < .001$, partial $\eta^2 = .520$. Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value and found that over time there was a significant effect for all the examined variables.

The main effect of nutritional risk was statistically significant over time, $F(1.58, 111.87) = 17.42$, $p < .001$, partial $\eta^2 = .197$. Higher scores in the nutritional risk scale indicated lower scores of nutritional risk (Bailey, 2005); thus as predicted, the LSD pairwise comparisons revealed a significant improvement in nutritional risk scores from baseline to week 6 (mean difference = 4.69, $p < .001$), and from baseline to week 12 (mean difference = 4.89, $p < .001$). No significant changes were found from week 6 to 12 ($p = .747$). The main effect of uncontrolled eating was statistically significant over time, $F(1.82, 129.12) = 8.06$, $p = .001$, partial $\eta^2 = .102$. LSD pairwise comparisons revealed no significant changes in uncontrolled eating scores from baseline to week 6 ($p = .051$). However; significant decrease in uncontrolled eating scores was found from baseline to week 12 (mean difference = -1.83, $p = .001$), and from week 6 to 12 (mean difference = -.90, $p < .05$) which indicated that over time participants engaged in less uncontrolled eating or tendency to lose control over eating (Bailey, 2005). The main effect of cognitive restraint was statistically significant over time, $F(2, 142) = 28.89$, $p < .001$, partial $\eta^2 = .289$. As predicted, the LSD pairwise comparisons revealed significantly increased cognitive restraint scores from baseline to week 6 (mean difference = 1.10, $p < .001$) and baseline to week 12 (mean difference = 1.43, $p < .001$) indicating that over time participants had higher

cognitive restraint or tendency to control food intake. However; no significant changes were found from week 6 to 12 (p = .104) for cognitive restraint. The main effect of emotional eating was statistically significant over time, $F(2, 142) = 3.13$, p = .047, partial η^2 = .042. LSD pairwise comparisons revealed no significant changes in emotional eating scores from baseline to week 6 (p = .078), and from week 6 to 12 (p = .552). However; a significant decrease in scores was found for emotional eating from baseline to week 12 (mean difference = -.93, $p < .05$) indicating that from baseline to week 12 participants engaged in less emotional eating or the tendency to overeat due to negative mood states.

Energy intake and expenditure. Intervention effects for energy intake and expenditure variables including physical activity energy expenditure, dietary intake consumption, and participant's self-reported accuracy of their physical activity and dietary intake record were examined. The descriptive statistics for each variable is displayed in Table 4.11. Physical activity energy expenditure levels indicate levels of physical activity, and dietary intake energy consumption levels indicate food and drink consumption. It is ideal that the accuracy of physical activity and dietary intake log scores are high and remain consistent over time suggesting that participants remained accurate in their records. A 3 x 3 MANOVA using an identical design to the previous analyses was conducted to examine the effect of the intervention on the energy intake and expenditure measures as outcome variables. The multivariate test revealed that there was no statistically significant main effect for condition, Wilks' Lambda = .916, $F(8, 114) = .64$, p = .746, partial η^2 = .043. No main Condition by Time interaction was found, Wilks' Lambda = .691, $F(16, 106) = 1.35$, p = .184,

partial η^2 = .169. However; a statistically significant main effect for time was found with Wilks' Lambda = .037, $F(8, 53) = 171.63$, $p < .001$, partial η^2 = .963.

Planned univariate follow-up tests for the MANOVA examined the significant main effect of time using the Huynh-Feldt value. The results found that only the main effect of physical activity energy expenditure was significant over time, $F(1.12, 66.94) = 45.34$, $p < .001$, partial η^2 = .430. LSD pairwise comparisons revealed that physical activity energy expenditure levels did not significant change from baseline to week 6 (p = .522) indicating consistent levels of physical activity within the first six weeks of the program. However; contrary to predictions a significant decrease in physical energy expenditure levels were found from baseline to week 12 (mean difference = -1194.53, $p < .001$), and from week 6 to 12 (mean difference = -1330.10, $p < .001$) indicating that over time participants engaged in less physical activity, evident from week 6 onwards. The main effect of dietary intake energy was statistically non-significant over time $F(1.78, 106.67) = .25$, p = .754, partial η^2 = .004. This finding suggests that dietary intake consumption remained consistent throughout the 12-week intervention.

As displayed in the descriptive statistics Table 4.11, both physical activity and dietary intake accuracy at baseline was found to be high at all three time points. Specifically, on average the HEALTHI participants responded that at baseline their physical activity and dietary intake records were 90.16% accurate. As ideal, the main effects for both physical activity energy expenditure and dietary intake energy, self-reported accuracy of records was found to be statistically non-significant over time, respectively with $F(1.55, 92.84) = 1.79$, p = .180, partial η^2 = .029 and $F(2, 120)$ =

.25, $p = .781$, partial $\eta^2 = .004$; this suggested that the accuracy of records remained consistently high over time.

Program compliance. A 3 (Conditions) x 2 (Time of measurements: week 6 and 12) MANOVA was conducted to examine program compliance with the variables inclusive of participant's self-reported beliefs about their compliance with the program guidelines of (1) engagement in the physical activity and (2) dietary intake weight-loss recommendations. The multivariate test revealed that there was no statistically significant main effect for condition, Wilks' Lambda = .979, $F(4, 126) = .34$, $p = .852$, partial $\eta^2 = .011$. In addition, no main Condition by Time interaction was found, Wilks' Lambda = .988, $F(4, 126) = .19$, $p = .943$, partial $\eta^2 = .006$. However; a statistically significant main effect for time was found for program compliance with Wilks' Lambda = .859, $F(2, 63) = 5.16$, $p < .01$, partial $\eta^2 = .141$.

Planned univariate follow-up tests for the MANOVA main effect of time were examined using the Huynh-Feldt value. The main effect of physical activity program compliance was statistically non-significant over time, $F(1, 64) = 1.66$, $p = .202$, partial $\eta^2 = .025$. However; the main effect of dietary intake program compliance was found to be statistically significant over time $F(1, 64) = 10.31$, $p < .01$, partial $\eta^2 = .139$. Contrary to expectations, LSD pairwise comparisons revealed that dietary intake program compliance scores significantly decreased from week 6 to 12 (mean difference = -1.30, $p < .01$) which indicated that participants' compliance with the dietary intake guidelines decreased towards the end of the program.

Discussion

The purpose of the present study was to examine the effects of the HEALTHI program, a theory-based intervention using implementation intentions and mental imagery strategies to promote adherence to dietary intake and physical activity guidelines in overweight and obese individuals, on biomedical, psychological, and behavioural outcome variables at baseline, week 6 and 12. An additional purpose of the study was to evaluate whether mobile phone goal-reminder text messages were effective in augmenting the effects of the intervention on the outcome variables. The intervention adopted a 12-week randomised-controlled design with overweight or obese participants allocated to one of three conditions: (1) a psycho-education plus an implementation intentions and mental imagery condition; (2) a psycho-education plus an implementation intentions and mental imagery condition with text messages; or (3) a psycho-education weight-loss condition. The intervention was delivered via an online system incorporating video presentations to increase the intervention's applicability in multiple contexts and reduce delivery cost.

Results revealed no main effects of the intervention or interactive effects of the intervention and time of measurement on any of the outcome variables. However; there were effects of time of measurement on some of the outcome variables indicating adaptive changes in key outcomes related to cardiovascular health and reduced risk of chronic conditions in all the intervention conditions, including the psycho-education weight-loss condition. The absence of effects of the intervention components above and beyond the psycho-education weight-loss condition in the present study may be due to the pervasiveness of the content of the psycho-education weight-loss condition which also included information on goal setting. However,

further research is needed to attain whether this is the case, as a study design with a non-intervention control condition is necessary to evaluate whether the additional components received by the psycho-education weight-loss condition were effective in comparison to a control condition that receives no intervention components.

According to the theoretical basis of the HEALTHI program it was expected that the intervention conditions, which included strategies of implementation intentions and mental imagery and, in one condition, goal-reminder text messages, would have increased intervention effects relative to the psycho-education weight-loss condition. However; results may suggest that the content and intensiveness of the weight-loss psycho-education and goal setting information provided to participants assigned to the psycho-education weight-loss condition appeared to be sufficient in evoking similar changes to the intervention conditions. The absence of a non-intervention control condition within the study design did not allow us to examine whether the changes in outcomes over time were attributable to behaviour-change components in the psycho-social education program delivered to participants in the psycho-education weight-loss condition or other extraneous factors. For example, present findings could be due to the participants in the current sample being motivated to lose-weight at baseline and hence signing up for the HEALTHI program. The psycho-education program included self-efficacy enhancing, goals setting, and self-monitoring techniques such as demonstrations of healthy eating, physical activity, and examples on how to engage in these health behaviours. Information on how to calorie counting and engage in exercise was also discussed, with participants formulating goals on how to achieve the guidelines on dietary intake and physical activity behaviour. These results indicate that these components

may be effective to assist overweight or obese participants to change dietary intake and physical activity behaviour to promote weight-loss and reduction of obesity-related risk factors. This finding is consistent with research in the area of health behaviour and weight-loss interventions. Self-monitoring of behaviour has been found to assist in the process of facilitating behaviour change as an individual is led to record and pay attention to their behaviour, (Burke, Wang, & Sevick, 2011). A systematic review that examined behavioural weight-loss studies that involved self-monitoring of diet, exercise, and self-weighing behaviour found that the process of self-monitoring is related to weight-loss (Burke et al., 2011). Self-monitoring is also believed to lead to goal progress evaluation and positive reinforcement due to this goal progress, as suggested by self-regulatory theory (Kanfer, 1991). In addition, the formation of achievable goals is believed to increase self-efficacy and therefore behaviour change, as suggested by social cognitive theory (Bandura, 1991). Self-efficacy may have also increased due to the intervention's provision of examples of healthy eating and exercise engagement which promote feedback.

Study results indicated that regardless of the intervention condition, that there were changes in the some of the measured biomedical, psychological, and behavioural outcomes and variables across time of measurement. Specifically, improvements were observed in the biomedical variables of body weight, body fat percentage, waist-hip circumference ratio, systolic and diastolic blood pressure, low-density lipoprotein, total cholesterol, triglycerides, blood glucose and insulin levels. These findings are consistent with other studies that have found that weight-loss leads to improvements in reducing obesity-related risk factors (Blackwell, 2002; Wing et al., 2011). The study findings also revealed positive improvement in quality

of life over time which is consistent with the finding that participants' body weight decreased across time. Depression symptoms also appeared to improve from baseline to week 6; however symptoms did not improve further from week 6 to 12. This finding is interesting as physical activity levels also appeared to increase from baseline to week 6, however declined from week 6 to 12. Research has found support that regular engagement in physical activity may assist with depression symptom management (Mello et al., 2013; Nieman, 2002). Participant's anxiety and stress levels were also observed to remain consistent over time which was ideal given these symptoms (and depression) were within normal ranges at baseline and the follow-up time points (Lovibond & Lovibond, 1995).

Relatively few changes in the HAPA variables were found. Significant findings were found over time for the HAPA variable of risk perception, dietary intake intentions and motivation, and physical activity maintenance self-efficacy and motivation; however contrary to predictions a decrease in scores was found from baseline relative to some of the follow-up time points. This suggests that during the HEALTHI program, participant's perception of risk, intentions motivation, and self-efficacy declined over time. However; physical activity planning was found to significantly increase over time at week 6 and 12 relative to baseline.

The results revealed improvement in eating behaviours relative to some of the previous time points, with higher cognitive restraint or tendency to control food intake, less uncontrolled eating or tendency to lose control over eating, and less emotional eating or the tendency to overeat due to negative mood states. In addition, it was found that across time energy consumption through dietary intake was statistically non-significant indicating that participant's dietary intake consumption

was consistent throughout the 12-week period. However; it was found that participants' energy expenditure or physical activity levels improved from baseline to week 6, and physical activity levels decreased from week 6 to 12.

The finding that participants' engagement in physical activity declined over time is important. This finding could be explained in light of the finding that, over time, participants' perception of risk associated with obesity also declined. In addition, participants' level of motivation to change dietary intake and physical activity behaviour also decreased over time. Over time participants' maintenance self-efficacy related to physical activity also decreased, which may be reflected in that participants also engaged in decreased physical activity levels. Although physical activity planning scores appeared to significantly improve at week 6 and 12 relative to baseline, it was also found that no significant change occurred from week 6 to 12. This week 6 to 12 period is when participant's physical activity levels appeared to decline. The HAPA predictions would support these findings. The HAPA highlights the importance of planning as a link to behaviour engagement such as physical activity. The results found that in the time periods that planning increased so did physical activity expenditure. This highlights the importance of planning as a possible predictor of behaviour engagement. The mediation of the intervention effects by the HAPA variables on the outcomes was not tested as the intervention was not correlated with the HAPA variables. Examination of the HAPA variables and their impact on the outcome variables is examined in the subsequent chapters.

It is important to note that other studies adopting similar intervention strategies, although using a somewhat different design, have also found null effects for the intervention strategies of implementation intentions and mental imagery. For

example, a study by Jackson and colleagues (2005) found that implementation intentions did not improve consumption of fruit and vegetables within a student population; this study examined behaviour change over a three month period and used the theory of reasoned action. Also, a study by Koka and Hagger (in press) found null effects for mental stimulation and action planning strategies, or the interaction of the two strategies, to increase adolescent physical activity levels; this study used a brief theory-based intervention that examined behaviour over a three month period.

The study by Koka and Hagger (in press) found that although mental stimulation and action planning strategies alone, or the interaction of the two strategies, did not increase physical activity levels, participants with low baseline physical activity levels in the mental stimulation alone and action planning alone conditions were found to have higher levels of physical activity at the one month follow up. These results suggest that each of the intervention strategy component may be effective to assist behaviour change in adolescents with low physical activity levels. The current study did not examine any moderator effects and future research may benefit from conducting a systematic review of the research literature to identify whether there are any fundamental differences between studies that have found intervention effects versus lack of effects. It would also be helpful to examine studies that used a 'no-intervention' control condition that contains no planning or intervention components versus a comparison condition such as that adopted within the current study.

Contributions, Strengths and Limitations

Contributions and strengths. An important strength of the current study is that the intervention design was based on theory (Michie & Johnston, 2012). In addition, the HEALTHI program led to improvement in engagement in health behaviour and the reduction of biomedical and psychological obesity-related risk factors. In addition, the intervention delivery method was internet based via the Qualtrics™ program which included the video presentations and required activities; this is an important study contribution and strength as the intervention could be "rolled out" in the health setting by health practitioners. An advantage is that the program is evidence based, cost effective, requires minimal contact, has flexibility in delivery method, and is easily accessible online.

The present study also contributed to the literature as the HEALTHI program appeared to be effective in assisting overweight and obese adults to engage in health behaviours related to dietary intake and physical activity to facilitate weight-loss and reductions in obesity-related risk factors. The study findings provided valuable information about the strategies needed to facilitate health-behaviour change. The information provided to the psycho-education weight-loss condition appeared to be sufficient in evoking similar changes to the intervention conditions, thus highlighting the importance of psycho-education and goal setting information in leading to engagement in health behaviour without the need for additional strategies such as mental imagery, implementation intentions, or goal-reminder text messages. The information provided to the psycho-education weight-loss condition (and intervention conditions) appeared to evoke positive changes and the behaviour change techniques of providing examples, self-monitoring of physical activity and

diet (such as calorie counting), and goal formulation could be incorporated in future weight-loss interventions to promote weight-loss and reduction of obesity-related risk factors.

Limitations. A study limitation was that the psycho-education weight-loss condition was intensive with access to psycho-education weight-loss information and information on goal setting; as the psycho-education weight-loss condition included techniques that may have been sufficiently influential to change behaviour, we were unable to evaluate whether the additional techniques provided to the intervention conditions (implementation intentions and mental imagery with and without text messages) were as effective as the self-monitoring and self-efficacy promoting techniques contained in the psycho-education weight-loss condition due to the lack of a non-intervention control condition. The study design did not have a non-intervention control condition and hence we were unable to examine whether the positive outcomes would have been found even in the absence of an intervention. In addition, the finding that the psycho-education weight-loss condition appeared to be sufficient in evoking similar changes to the intervention conditions, could be due to the participant sample being motivated to lose weight, thus volunteering to engage in the HEALTHI program and may have lost weight without any form of intervention. This could be examined through the inclusion of a non-intervention control condition within the study design.

In addition, although efforts were made to recruit participants external to Curtin University it was found that the most successful advertising and as a result participant recruitment occurred from the methods used within the university such as the Curtin University website announcement. This may lead to generalisability issues

which could not be managed outside the researcher's control. Efforts were made to source participants from outside the university, however the interest was not as abundant. For this reason, the concern is stated to ensure the reader is aware of the issue when examining the study conclusions and results.

Information supplementary to the examination of the intervention effects

When examining the intervention effects, some of the biomedical variables described in Chapter 3 were not included in the analyses of the intervention effects. That is, the b*ody composition* variables including bone mass, body fat percentage, and muscle mass measured using the whole body dual-energy X-ray absorptiometry (DEXA, Lunar Prodigy; Lunar, Madison, WI, USA) at baseline and week 12 (Hattar et al., 2015). These variables were removed as a correlation analyses indicated that at baseline body weight (kilograms) was highly correlated with the baseline body composition measures of: lean body mass (grams) ($r = .842$, $p < .001$), DEXA total fat mass (grams) ($r = .764$, $p < .001$), DEXA total lean mass (grams) ($r = .815$, $p < .001$) and DEXA total body mass (grams) ($r = .999$, $p < .001$). These findings indicated considerable redundancy across these measures and we opted to exclude them on this basis.

CHAPTER FIVE: Predicting Physical Activity-Related Outcomes in Overweight and Obese Adults: A Health Action Process Approach

Introduction to Predicting Physical Activity-Related Outcomes

This chapter provides an overview of a study that tested the Health Action Process Approach (HAPA) in which changes in the model constructs across the study time points predicted changes in psychological, body composition, and cardiovascular risk outcomes. The model was tested with respect to physical activity participation in overweight and obese adults who engaged in the HEALTHI program. This study was published in a truncated form as a journal article and the accepted manuscript version of the article is provided below.

Hattar, A., Hagger, M. S., and Pal, S. (2016). Predicting physical activity-related outcomes in overweight and obese adults: A Health Action Process Approach. *Applied Psychology: Health and Well-being*, *8*(1), 127-151. doi:10.1111/aphw.12065[4]

Predicting Physical Activity-Related Outcomes in Overweight and Obese Adults: A Health Action Process Approach

Abstract

Background. We tested the adequacy of a model based on the Health Action Process Approach (HAPA) in predicting changes in psychological, body composition

[4]

and cardiovascular risk outcomes with respect to physical activity participation in overweight and obese adults.

Methods. Measures of HAPA constructs (action and maintenance self-efficacy, outcome expectancies, action planning, risk perceptions, intentions, behaviour), psychological outcomes (quality of life, depression, anxiety, stress symptoms), body composition variables (body weight, body fat mass), cardiovascular risk measures (total cholesterol, low density lipoprotein), and self-reported physical activity behaviour were administered to participants (n = 74) at baseline, and 6 and 12 weeks later.

Results. Data were analysed using variance-based structural equation modelling with residualised change scores for HAPA variables. The model revealed effects of action self-efficacy and outcome expectancies on physical activity intentions, action self-efficacy on maintenance self-efficacy, and maintenance self-efficacy and intentions on action planning. Intention predicted psychological and body composition outcomes indirectly through physical activity behaviour. Action planning was a direct predictor of psychological, cardiovascular, and body composition outcomes.

Conclusions. Data supported HAPA hypotheses in relation to intentions and behaviour, but not the role of action planning as a mediator of the intention-behaviour relationship. Action planning predicted outcomes independent of intentions and behaviour.

Practitioner Points

- The current study examined a modified version of the Health Action Process Approach and provided evidence to inform behavioural interventions that will be optimally effective in changing physical activity behaviour and related outcomes.
- The model indicates that interventions that promote action and maintenance self-efficacy (e.g., providing experiences of success, positive feedback, appropriate role models) will likely lead to improvements in both physical activity behaviour and action planning (e.g., stating when and where the behaviour should be performed). The model also indicated that both behaviour and action planning are independent predictors of clinically-relevant outcomes including psychological, body composition, and cardiovascular risk outcomes.
- The current model indicates how changes in the psychological variables (e.g., action and maintenance self-efficacy, outcome expectancies, action planning, intentions, and behaviour) are related to changes in psychological, body composition, and cardiovascular risk outcomes, effects that are not routinely explored in tests of social cognitive models applied to health behaviour.

Background

Obesity and overweight are linked to multiple chronic health conditions and illnesses including cardiovascular disease and diabetes (World Health Organization, 2012). The main cause of overweight and obesity is an imbalance between the amount of energy consumed and expended, highlighting sufficient physical activity as an important means to maintain a healthy weight and to achieve weight-loss (WHO, 2012). Physical activity may also help in reducing incidence of metabolic risk factors linked to chronic conditions and illnesses in overweight and obese individuals (WHO, 2012). Blackwell (2002) reports that weight-loss is important to lower elevated levels of total cholesterol and low-density lipoprotein in overweight and obese adults. Even in the absence of weight-loss it has been found that physical activity leads to improvements in risk factors associated with chronic diseases like cardiovascular disease such as cholesterol and blood pressure (Ho et al., 2012a; Ho, Dhaliwal, Hills, & Pal, 2012b, 2013; Shaw et al., 2006). Physical activity guidelines in America and Australia suggest that to receive health benefits adults should engage in a minimum of 30 minutes of moderate activity on most or all days of the week (Norton et al., 2010; Pal, Cheng, & Ho, 2011). Similarly, Australia's Physical Activity and Sedentary Behaviour Guidelines for Adults (Department of Health, 2014) recommend that adults are active on most, preferably all, days of the week. Regular physical activity has also been found to lead to better psychological and affective outcomes (Gill et al., 2013). For example, physical activity has been found to relate to better management of symptoms of stress, anxiety, and depression (Mello et al., 2013). In addition, research has found that being overweight impacts on an individual's quality of life with weight having a negative correlation with the quality

of life level within both clinical and community populations (Fontaine & Barofsky, 2001; Gill et al., 2013; Kolotkin, Crosby, Williams, Hartley, & Nicol, 2001; Kushner & Foster, 2000; Wright et al., 2013). Studies have found that improvement in quality of life is apparent following weight-loss (Kolotkin et al., 2001; Mamplekou, Komesidou, Bissias, Papakonstantinou, & Melissas, 2005; Wright et al., 2013).

According to the 2011-2012 National Nutritional and Physical Activity Survey (Australian Bureau of Statistics, 2013), 36% of Australian adults were classed as insufficiently active and did not meet guideline physical activity levels of at least 150 minutes of activity over five or more sessions per week. It is critical to study this population and understand the factors that influence their health compromising behaviour. Understanding the psychological factors that influence obese and overweight people's motives and decisions to engage in unhealthy behaviours is an important endeavour. Researchers in health psychology and behavioural medicine have aimed to identify the theory-based modifiable psychological factors that should be targeted in behavioural interventions to evoke a change in health behaviour such as physical activity. This information can be used to guide the adoption of appropriate techniques that may contribute to changes in psychological factors most strongly related to physical activity (Hagger & Hardcastle, 2014; Michie & Johnston, 2012). Adopting a theoretical basis provides an explanatory system to identify the psychological constructs that could be targeted by specific behaviour-change techniques and mediate the effect of the techniques on key health-related outcome variables (Hagger & Luszczynska, 2014; Knäuper et al., 2011). Such an approach allows researchers to propose specific hypotheses as to how

a particular technique may evoke behaviour change and how the technique operates. The hypotheses can then be confirmed or rejected against observation.

The current study adopted the Health Action Process Approach (HAPA; Schwarzer, 2008), a widely-used social psychological model that has been used to identify components related to changes in weight-loss behaviours and how the various components inform the intervention content to highlight the change process. The aim of the current study is to examine the effectiveness of the HAPA variables in predicting changes in psychological outcomes, body composition and cardiovascular risk in overweight and obese adults within the context of behaviour-change in a physical activity intervention.

Health Action Process Approach

The HAPA is a social cognitive model that aids understanding of health behaviour by providing a solution to the problem that forming strong intentions does not always lead to behaviour change, often referred to as the intention-behaviour 'gap.' The model is distinct from other social cognitive approaches because it specifies two phases of action, that lead to the enactment of health behaviour: a *motivational* phase, which describes the process by which individuals form intentions to change behaviour, and a *volitional* phase, which describes the process by which individuals implement their intentions to perform the actual behaviour (Schwarzer, 2008). By contrast, many other social cognitive approaches focus on the motivational phase alone, which has been identified as a limitation (e.g., Sniehotta, Presseau, & Araújo-Soares, 2014). This makes the HAPA ideal as a guide for the current study as it will provide a comprehensive template for processes that lead to intention

formation and, importantly, how intentions are enacted in the context of physical activity. In terms of specific hypotheses, the model suggests that *intentions* (e.g., how much participants intend to participate in the recommended physical activity) are related to *action planning* (e.g. whether participants made a detailed plan about when, where and how they would engage in physical activity), which then influences *action*. Specifically, action planning is depicted as the key mediating factor by which intentions are enacted.

The motivational phase of the HAPA describes the process by which individuals form intentions to perform health behaviours (Schwarzer & Luszczynska, 2008). Three social-cognitive belief-based constructs that give rise to intentions are identified: *risk perception* (e.g., perceived risk of developing obesity-related risk factors), *outcome expectancy* (e.g., participants' expectation of the effect of physical activity), and *action self-efficacy* (e.g., participants' belief in their ability to engage in the recommended physical activity guidelines). These three variables are proposed to directly relate to intentions. Individuals, therefore, form their intentions based on these sets of beliefs. Once an individual has formed the intention to perform the action, the volitional phase is critical to behavioural enactment. Within this phase self-efficacy and planning are key variables. There are various types of perceived self-efficacy: *action self-efficacy* describes the individuals belief in their ability to perform action; *maintenance self-efficacy* describes the individual's beliefs regarding their ability to deal with barriers that may arise; *recovery self-efficacy* describes the individual's experience of setbacks and the trust they have in their ability to recover (Schwarzer & Luszczynska, 2008). Action self-efficacy is believed to have a direct effect on maintenance self-efficacy, which is directly related to *action planning.*

Action planning refers to the formation of detailed plans of when, where and how the behaviour will be performed. The HAPA model emphasises that the steps for the action formation are necessary to convert good intentions to actual behaviour change (Schwarzer, 2008).

Evidence Supporting the HAPA

The HAPA is well supported by empirical research in multiple health behaviours and contexts. Studies have illustrated that the HAPA framework is effective in predicting physical activity (Barg et al., 2012; S Lippke, Ziegelmann, & Schwarzer, 2004; Parschau et al., 2014; Scholz et al., 2005; Sniehotta et al., 2005; Ziegelmann, Lippke, & Schwarzer, 2006). For example, Barg and colleagues (2012) examined predictors of physical activity using a sample of inactive middle-aged women and illustrated that the main hypotheses relating to the HAPA predictions are supported. This includes, action self-efficacy and outcome expectancies significantly predicted intentions, and outcome expectancies affect planning indirectly through intentions. Intentions and maintenance self-efficacy significantly predicted planning, and action self-efficacy affected planning indirectly through intentions. Risk perception was not found to predict intention which is in contrast to model hypotheses. Another study by Parschau and colleagues (2014) examined the applicability of the HAPA in relation to physical activity in an obese adult sample. The study found that intentions were related to motivational self-efficacy and outcome expectancies. However, no relationship was found between planning and physical activity. In addition, consistent with Barg and colleagues (2012) the study found no relationship between risk perception and intentions. Overall, research has

generally provided support for the model in predicting health behaviours in a number of domains.

To date, a number of research studies have been correlational and prospective in design and focused on behavioural prediction rather than behaviour change. While prediction of variance in health behaviour and its antecedents has value, such approaches have been criticised as focusing exclusively on explanation and not explaining change (Sniehotta, Presseau, & Araújo-Soares, 2015). This is particularly important when one regards the typically strong effects of past behaviour and habit on prospectively-measured behavioural outcomes over time, and the strong auto-regressive effects of psychological factors on themselves over time (Lindwall, Larsman, & Hagger, 2011). Studies that do not account for the temporal stability of social cognitive predictors and behaviour, lack validity as true, ecologically-valid accounts of behaviour. This is because they fail to account for the dynamic changes in behaviour over time (i.e. mediation of the past behaviour-future behaviour relationship, modelling the effects of habits). To date, there have been a number of studies, many of them adopting cross-lagged panel design with autoregressive techniques, that have predicted change and controlled for the stability of psychological constructs over time, in the context of social cognitive models of health behaviour (Davis, 1985; Hagger, Chatzisarantis, & Biddle, 2002a, 2002b; Jacobs, Hagger, Streukens, De Bourdeaudhuij, & Claes, 2011; Liska, Felson, Chamlin, & Baccaglini, 1984; Scholz, Nagy, Gohner, Luszczynska, & Kliegel, 2009). The aim of the current research was to examine the effect of dynamic changes in HAPA variables on multiple behavioural outcomes and independently examines the predictive value of both action planning and behaviour on outcome variables.

Previous research testing of social cognitive models such as the HAPA have focused on accounting for behavioural outcomes, which is consistent with these kinds of models given that behavioural prediction is their goal. Nevertheless, from the perspective of 'clinical significance' (Jacobson & Truax, 1991) it is useful to know whether changes in the behaviour predicted by the model variables have a concomitant effect on outcomes that serve to indicate reduced risk from chronic illness and better health. In the context of physical activity promotion, for example, it would be useful to know that changes in social cognitive variables that are the antecedents of behaviour led to actual changes in indices of better cardiovascular and psychological health, the key outcomes that are expected to be affected due to changes in physical activity, the behavioural mediator. It would therefore be valuable to indicate that changes in the HAPA constructs was related the changes in indices of cardiovascular health, healthy weight maintenance, and psychological health mediated by changes in behaviour. In the current study we aimed to test these relationships to demonstrate the mediation of the effects of the model constructs on outcomes of clinical significance brought about by changes in behaviour.

The Present Study and Hypotheses

The purpose of the present study was to examine the HAPA constructs for physical activity in predicting change in key health-related outcomes in overweight and obese individuals from baseline to week 6 and 12 undergoing a weight-loss intervention. The hypothesised relations among the HAPA variables in the present study are summarised in Table 5.1. There is also an accompanying Figure to guide the hypothesised relations among study variables (*see* Appendix S, Figure S1). We

have detailed each hypothesised relationship in the next sections using Table 5.1 and Figure S1 as a guide. It is important to note that in the Table and Figure, the constructs reflect a *change* in the construct across study time points.

Table 5.1

Summary of hypothesised direct and indirect effects in the proposed model based on the HAPA

H	Independent variable[a]	Dependent variable	Mediator/mediators
H_1	Action self-efficacy	Intention	–
H_2	Outcome expectancies	Intention	–
H_3	Risk perception	Intention	–
H_4	Action self-efficacy	Maintenance self-efficacy	–
H_5	Maintenance self-efficacy	Action planning	–
H_6	Intention	Action planning	–
H_7	Action planning	Behaviour	–
H_{8a}	Behaviour	Psychological outcome	–
H_{8b}	Behaviour	Body composition outcome	–
H_{8c}	Behaviour	Cardiovascular risk outcome	–
H_{9a}	Action planning	Psychological variable outcome	–
H_{9b}	Action planning	Body composition outcome	–
H_{9c}	Action planning	Cardiovascular risk outcome	–

H_{10}	Action planning	Behaviour	–
H_{11a}	Action self-efficacy	Action planning	Intention
H_{11b}	Action self-efficacy	Action planning	Maintenance self-efficacy
H_{12}	Action self-efficacy	Behaviour	Intention
H_{13}	Intention	Behaviour	Action planning
H_{14a}	Intention	Psychological outcome	Behaviour
			Action planning
H_{14b}	Intention	Body composition outcome	Behaviour
			Action planning
H_{14c}	Intention	Cardiovascular risk outcome	Behaviour
			Action planning
H_{15a}	Action Planning	Psychological variable outcome	Behaviour
H_{15b}	Action Planning	Body composition outcome	Behaviour
H_{15c}	Action Planning	Cardiovascular risk outcome	Behaviour

Note. [a]All variables in the proposed model reflect changes in the variable across the intervention computed by regressing the follow-up measure of each variable (week 12) on the previous measures (baseline and week 6 measures). R^2 = Explained variance in dependent variable.

Direct effects. Based on the HAPA, we predicted that changes in action self-efficacy (H_1), outcome expectancies (H_2), and risk perception (H_3) would predict changes in intention. We also predicted that changes in action self-efficacy would be related to changes in maintenance self-efficacy (H_4), and changes in maintenance self-efficacy would be predict changes in action planning (H_5). In addition, we

predicted that changes in intention will predict changes in action planning (H_6) and physical activity behaviour (H_7). We also hypothesised that changes in behaviour will predict changes in the psychological (H_{8a}), body composition (H_{8b}), and cardiovascular risk (H_{8c}) outcome variables. Action planning was also hypothesised to have a direct effect on the psychological (H_{9a}), body composition (H_{9b}), and cardiovascular risk (H_{9c}) outcomes. Finally, we predicted a direct effect of action planning on behaviour (H_{10}).

Indirect effects. We also hypothesised a series of indirect effects in the model based on HAPA predictions. We hypothesised indirect effects of changes in action self-efficacy on changes in action planning, mediated by changes in intention (H_{11a}) and changes in maintenance self-efficacy (H_{11b}). We also hypothesised indirect effects of changes in action self-efficacy on changes in behaviour mediated by changes in intention (H_{12}). Changes in intention were expected to predict changes in behaviour mediated by changes in action planning (H_{13}). Changes in intention were expected to predict changes in the psychological (H_{14a}), body composition (H_{14b}), and cardiovascular risk (H_{14c}) outcomes mediated by changes in action planning and behaviour. In addition, changes in action planning were predicted to have an indirect effect on psychological (H_{15a}), body composition (H_{15b}), and cardiovascular risk (H_{15c}) outcomes mediated by changes in behaviour.

Method

Design. The current study adopted an intervention-controlled three-wave prospective design with HAPA constructs (action self-efficacy, maintenance self-efficacy, outcome expectancies, risk perception, intention, action planning, and

behaviour), body composition (body weight and body fat mass), cardiovascular risk (total cholesterol and low density lipoprotein), and psychological (quality of life, and depression, anxiety, and stress symptoms) outcomes measured at an initial data collection occasion (baseline) and at 6- and 12-week (excluding body fat mass which was only measured at baseline and week 12). Data were collected as part of an intervention study in which overweight and obese participants were randomly-allocated to one of three conditions to complete a 12-week Healthy Eating and Active LifesTyle Health Intervention (HEALTHI). The HEALTHI program required participants to adhere to guidelines related to dietary intake (consume a calorie intake within their specified minimum and maximum amount) and physical activity (to be physically active, and to engage in a minimum of 30 minutes of planned daily exercise). Participants were encouraged to engage in moderate to vigorous physical activity. The three intervention conditions differed in content with respect to the behaviour change techniques included in the intervention. Participants allocated to the active control condition were provided with weight-loss information, examples of goals related to the diet and physical activity guidelines, and the opportunity to form goals to adhere to the dietary intake and physical activity recommendations. Participants allocated to the two intervention conditions received the weight-loss information and were also directed to form action plans (cue-dependent plans to engage in physical activity and healthy eating) and mental imagery (imagining the steps required to attain physical activity and healthy eating goals, and imaging having achieved the outcome or goal). The action planning and mental imagery targeted changes in the action planning and self-efficacy constructs from the HAPA, respectively. In addition, participants allocated to one of the intervention conditions

also received goal-reminder text messages to increase adherence to the planning and imagery exercises. The full protocol for the intervention is provided in a separate article outlining the specific details of the intervention content, study design, and method (Hattar et al., 2015). While participants in the three conditions differed in the behaviour-change techniques used, no intervention effects were found within the data used for the current study. For completion, we controlled for intervention effects in all study variables in order to completely negate any potential intervention effects. This trial was registered on the Australia and New Zealand Clinical Trials Registry (Trial registration number ACTRN12613001274763). Ethical approval for the trial was obtained from the Curtin University Human Research Ethics Committee.

Participants. Participants were recruited via various means including the Curtin University website and email system, flyers in local community organisations, a Western Australian Newspaper and social-networking websites. Potential participant's responded by completing an online questionnaire (Qualtrics^{TM}) which provided study information and screening items to ensure the individual met study inclusion criteria (e.g., aged 18 to 65 years, overweight or obese with a body mass index between 25 and 40) and not the exclusion criteria (e.g., serious health conditions, inability to engage in any form of physical activity, severe depression, inability to commit to follow-up clinic sessions)[5]. Participants that meet the inclusion criteria were invited to attend an orientation session at Curtin University which aimed to provide study information and was an opportunity to answer participant's questions. At the conclusion of the orientation session participants interested in the

[5]The protocol article by Hattar and colleagues (2015) provides a comprehensive list of intervention inclusion and exclusion criteria.

study were invited to enrol in the program. Appendix T provides details of participant flow through the intervention including a CONSORT (Consolidated Standards of Reporting Trials) diagram (*see* Figure T1, Appendix T). To aid in minimised dropout rates, text message appointment reminders were offered for participants to attend the follow-up sessions.

Participants provided informed consent to participate in the research study and for the data results to be published. Overweight or obese participants (N = 74*; M* age = 41.10 years, SD = 12.10; Body Mass Index (BMI) = 31.13, SD = 3.55) from Perth, Western Australia completed various measures at baseline after randomisation, and at follow-up data collection occasions 6 and 12 weeks later. Participants within the three original conditions did not differ on any of the demographic information. At baseline 37.84% of participants were overweight (BMI 25-29.9), 44.59% obese class 1 (BMI 30-34.9), and 17.57% obese class 2 (BMI 35-39.9). Of the 74 participants 63.5% were born in Australia, and 36.5% were born outside of Australia. Participant nationalities included White/Caucasian (75.7 %), Asian (6.8%), Black/African American (1.4%), other (14.9%) and the remainder did not provide their ethnicity (1.4%). The majority of the participants reported a high level for education, reporting completing education at university or tertiary level (75.7%), technical/trade certificate (6.8%), completed high school (13.5%) and the remainder left high school before completion (4.1%). The majority of participants were engaged in full time employment (60.8%), with a further in part time employment (28.4%), part time volunteers (2.7%), engaged in home duties (2.7%), working as a part time volunteer and in part time employment (2.7%), and the remainder did not provide their employment status (2.7%). Participants reported engaged in jobs that involved

predominately sitting (67.6%), standing and some walking (16.2%), predominately physical (12.2%), other (2.7%), and the remainder reported none (1.4%).

Measures

Health Action Process Approach. Self-report measures of the HAPA variables were administered at baseline and at week 6- and 12-weeks during the intervention, as adapted from Barg and colleagues' (2012) measures. The items are outlined in Appendix U (*see* Table U1). *Risk perception* was assessed using four items (e.g., "I think it is likely that I will develop health problems related to obesity at some point in my life") with responses provided on a six-point scales ranging from 1 (strongly disagree) to 5 (strongly agree). *Outcome expectancy* was assessed using three items (e.g., "I think that engaging in daily physical activity with a minimum of 30 minutes of planned exercise will help me to lose weight") with responses provided on five-point scales ranging from 1 (strongly disagree) to 5 (strongly agree). *Intention* was assessed with two items (e.g., "I intend to participate in daily physical activity with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks") with responses ranging from 1 (strongly disagree) to 5 (strongly agree). *Action self-efficacy* was measured using five items (e.g., "if it were entirely up to you, how confident are you that you would be able to participate in daily physical activity with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks?") with item responses ranging from 1 (not confident) to 5 (completely confident). Participants were informed of the guidelines as part of the intervention. *Maintenance self-efficacy* was measured using nine items (e.g., "how confident are you that you will do daily

physical activity with a minimum of 30 minutes of planned exercise during your leisure time on each individual occasion over the next 6 weeks even if…" followed by a list of barriers, such as, but not limited to bad weather and feeling tired) with responses ranging from 1 (not confident) to 5 (completely confident). *Action planning* was assessed using one item (e.g., "I have made a detailed plan about when, where, and how I will do daily physical activity with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks") with responses ranging from 1 (strongly disagree) to 5 (strongly agree).

Physical Activity Behaviour was measured at week 6 and 12 using two items measuring physical activity compliance (e.g., "On average, during the past 6 weeks, how often did you engage in at least 30 minutes of planned exercise?") with responses ranging from 1 ("7 days/week" or "always") to 5 (never). The questionnaire was derived from previous self-report measures of physical activity (Godin & Shephard, 1985) and has been used a behavioural measure in previous research testing effects of social cognitive models (e.g., Chatzisarantis, Hagger, & Brickell, 2008; Hagger & Chatzisarantis, 2006).

Body composition outcome. The body composition outcome comprised two variables. *Body weight* (kilograms) was measured at baseline, week 6 and 12, using a digital body composition monitor scale (Omron, model HBF 362). *Total body fat* measured in grams was measured using the whole body dual-energy X-ray absorptiometry (DEXA; Lunar Prodigy, Lunar, Madison, WI, USA) at baseline and 12 weeks; the DEXA apparatus was calibrated and a phantom scan undertaken daily.

Cardiovascular risk outcome. The cardiovascular risk outcome comprised two measures of cardiovascular risk shown to be sensitive to changes in physical activity: *total cholesterol* (TC) and *low-density lipoprotein* (LDL). The measures were taken from a venous blood sample taken within a three-day period prior to the baseline, week 6 and 12 clinic appointment and were analysed at an approved pathology laboratory.

Psychological outcome. Psychological variables were measured at baseline, week 6 and 12 using validated self-report measures. *Quality of life* was measured using the 31-item Impact of Weight on Quality of Life Questionnaire (Kolotkin & Crosby, 2002) that assesses the effect of obesity on quality of life in five domains: physical function, self-esteem, sexual life, public distress, and work. Scores on each domain are summed to provide an overall index of quality of life. Responses were made on five-point scales ranging from 1 (never true) to 5 (always true). The Depression Anxiety Stress Scales-21 (Lovibond & Lovibond, 1995) was used to measure symptoms of *depression*, *anxiety*, and *stress*. Participants rated their symptoms over the past week by answering 21-items with responses made on four-point scales anchored by 0 (did not apply to me at all) and 3 (applied to me very much, or most of the time).

Statistical analysis

Participant Attrition. Seventy-five participants commenced the HEALTHI program. Participant retention rates were high throughout the intervention. Four

participants withdrew from the study for personal reasons prior to the week 6 appointment, and a further three withdrew or did not attend the week 12 appointment. In addition, one participant's data was excluded from the analysis due to a low baseline body mass index of 24 which did not match the study inclusion criteria, leaving 74 participants eligible for analysis. To account for missing data, we conducted a full intention-to-treat analysis with last measured data points carried forward in order to provide a conservative estimate of hypothesised effects.

Analyses. Data used in this study was collected at baseline and after the intervention had been administered at 6- and 12-week follow-up occasions. Given the purpose of the current study was to test the efficacy of a model based on the HAPA in predicting study outcomes, we controlled for intervention effects, so any predictive effects in the test of the HAPA are independent of any variations due to the intervention. Reliability indices, means and standard deviations, and an intercorrelation matrix for study variables at baseline, week 6 and 12 are provided in Tables V1-V3 (*see* Appendix V).

Hypothesised relationships among constructs from the HAPA are illustrated in Figure S1 (*see* Appendix S). Data were analysed using variance-based structural equation modelling (VB-SEM), also known as partial least squares analysis. As our analysis focused on examining change in psychological, body composition, and cardiovascular risk outcome variables across study time points, we computed residualised change scores for each variable in the proposed model. Residualised change scores were calculated prior to the VB-SEM analysis by regressing the follow-up measure of each variable (week 12) on the previous measures (baseline and week 6 measures). Unstandardised residualised change scores were computed for

all the variables within the model including all the HAPA variables, psychological, body composition, and cardiovascular risk outcome variables, and physical activity behaviour variable. The residualised change scores also controlled for participants' intervention condition, age, and gender by including each of these control variables in the regression equation to compute the change scores. For the physical activity behavioural measure, baseline data was not available thus the residualised change scores controlled for week 6 scores only as well as intervention condition, age, and gender.

The VB-SEM was conducted using the Warp PLS v.5.0 statistical software (Kock, 2015). Effects were estimated using bootstrapped resampling method with 100 resamples as recommended by Kock (2015). VB-SEM analysis is similar to covariance based SEM analyses with both explicitly modelling measurement error through the use of latent variables. However, the partial least-squares algorithm is based on ranked data which means it is distribution free unlike covariance-based methods. This means the estimation is less affected by the model complexity, data non-normality, and small sample size.

Studies using VB-SEM approaches have been criticised for being used with small sample sizes without adequate statistical power analyses (Ringle, Sarstedt, & Straub, 2012). Ringle and colleagues suggest that for VB-SEM researchers can use power tables from regression (J. Cohen, 1992) to determine the minimum sample size needed for appropriate statistical power (Chin, 2010). In the current study sample size was determined by a power analysis for multiple regression with seven predictor variables (the four-predictor system being the most complex regression system in the proposed model), with statistical power set at .80 and alpha set at .05

(Faul, Erdfelder, Lang, & Buchner, 2007). A medium-to-large effect size (J. Cohen, 1992) was expected, consistent with meta-analyses of 94 studies that examined the effect of forming implementation intentions (Gollwitzer, 1999; Hagger & Luszczynska, 2014) similar to action planning, on goal attainment which showed an average positive effect size of 0.65 (Gollwitzer & Sheeran, 2006). Based on these factors and an estimated medium to large effect size ($f^2 = .25$) the power analyses revealed an estimated sample size of 65 participants is adequate for the current analyses.

Adequacy of the hypothesized model estimated using the VB-SEM in the current study was established using several accepted goodness-of-fit indices: the overall goodness-of-fit (GoF) index with .10, .25, and .36 corresponding to small, medium, and large effect sizes, respectively (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005), the average path coefficient (APC) and average R^2 (ARS) coefficient across the model, both of which are recommended to be significantly different from zero, and the average full variance inflation factor for model parameters (AVIF) which is recommended to be less than 5.00 for a well-fitting model and ideally less than 3.30 (Kock, 2015). Hypothesized effects were tested by calculating direct and indirect effects using a bootstrap resampling method with 100 replications (Kock, 2015).

An advantage of using an SEM approach is the use of latent variables, which permits the estimation of unmeasured factors based on a set of items proposed capture the essence of the construct of interest. In the current study we specified a number of latent variables for the outcome variables. The psychological variables of quality of life and symptoms of depression, anxiety and stress were set to indicate a psychological outcome latent variable. A body composition outcome latent variable

was estimated comprising measures of body weight and body fat mass. In addition, a cardiovascular risk latent variable was estimated from measures of total cholesterol and low-density lipoprotein outcomes. All of the indicators of these latent variables were residualised change scores controlled for demographic and baseline and 6 week measures of the variables.

Results

Model goodness of fit. The VB-SEM exhibited adequate model fit with the data according to multiple recommended indices with overall large effect sizes (Kock, 2015). Goodness of fit indices indicated that the model had large explanatory power according to the multiple criteria adopted with a values exceeding the recommended cut-offs (GoF = 0.54; APC = 0.31, $p < .001$; ARS = 0.32, $p < .001$; AFVIF = 1.76) (Kock, 2015). Factor correlations among, and R^2 statistics for, the latent variables included in the VB-SEM are provided in Table 5.2.

Model effects. Figure 5.1 displays the standardised path coefficients for the hypothesised direct effects in our model based on the HAPA. Parameter estimates for paths not depicted in Figure 5.1 for clarity are provided in Table W1 (*see* Appendix W). Next, we provide details of our tests of hypotheses from the HAPA.

Direct effects. As predicted there was a statistically significant direct effect of changes in both action self-efficacy (H_1, $\beta = .53$, $p < .001$) and outcome expectancies (H_2, $\beta = -.23$, $p = .017$) on changes in intention. However, although outcome expectancies on intentions was significant, the negative beta value indicated that participants that expected the outcome will be achieved, had lower intentions to

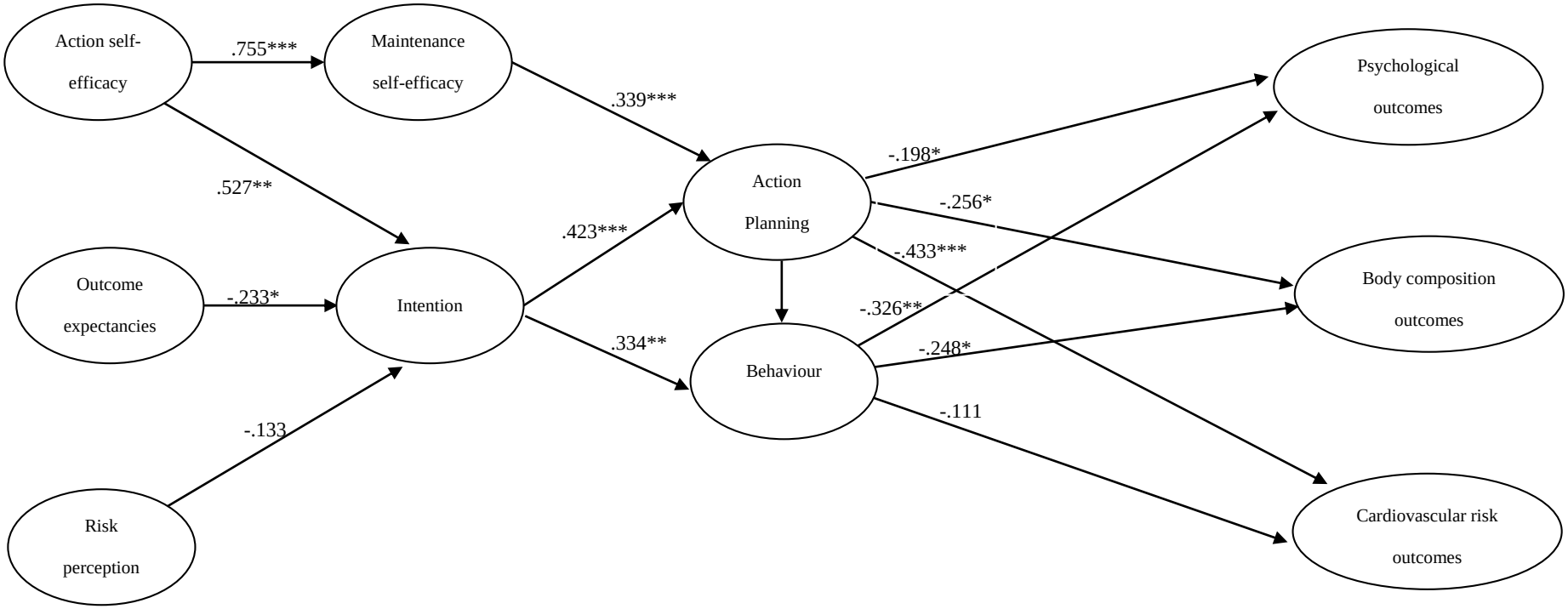
Table 5.2

Latent factor correlations and R^2 statistics for variables included in the proposed variance-based structural equation model

Variable[a]	R^2	1	2	3	4	5	6	7	8	9	10
1. Action self-efficacy	–	–									
2. Outcome expectancies	–	.02	–								
3. Risk perception	–	-.14	.08	–							
4. Maintenance self-efficacy	.57	.75***	-.04	-.09	–						
5. Intention	.47	.63***	-.12	-.10	.57***	–					
6. Action planning	.45	.43***	.04	.03	.52***	.59***	–				
7. Physical activity behaviour	.15	.31**	.03	-.17	.28*	.31**	.27*	–			
8. Psychological outcome	.26	-.22	-.05	.09	-.09	-.23*	-.24*	-.36**	–		
9. Body composition outcome	.18	-.32**	-.03	.16	-.33**	-.23*	-.27*	-.29*	.24*	–	
10. Cardiovascular risk outcome	.24	-.09	-.08	-.04	-.08	-.14	-.39***	-.17	.01	.36**	–

Note. [a]All variables are latent variables indicated by the residualised change score for the variable across the intervention computed by regressing the follow-up measure of each variable (week 12) on the previous measures (baseline and week 6 measures). R^2 = Explained variance in dependent variable. *p* * < .05 ** < .01 *** < .001

Figure 5.1. Standardised path coefficients of proposed effects among variables in the variance-based structural equation model



Note. All variables depicted in the diagram are residualised change scores for the variable across the intervention. Residualised change scores were computed by regressing the follow-up measure of each variable (week 12) on the previous measures (baseline and week 6 measures). * $p < .05$ ** $< .01$ *** $< .001$

engage in the behaviour contrary to hypotheses. There was no statistically significant direct effect of changes in risk perception on changes in intentions (H_3). There was a statistically significant direct effect of changes in action self-efficacy on changes in maintenance self-efficacy (H_4, $\beta = .76$, $p < .001$), as well as changes in maintenance self-efficacy on changes in action planning (H_5, $\beta = .34$, $p < .001$) consistent with hypotheses. Statistically significant effects were found for changes in intention on changes in action planning (H_6, $\beta = .42$, $p < .001$) and behaviour (H_7, $\beta = .33$, $p = .001$). Statistically significant effects for changes in behaviour on changes in the psychological (H_{8a}, $\beta = -.33$, $p = .001$) and body composition (H_{8b}, $\beta = -.25$, $p = .012$) outcomes. However, changes in behaviour were not found to have a statistically significant effect on changes in cardiovascular risk outcomes (H_{8c}). Statistically significant effects for changes in action planning on changes in psychological (H_{9a}, $\beta = -.20$, $p = .037$), body composition (H_{9b}, $\beta = -.26$, $p = .010$) and cardiovascular risk (H_{9c}, $\beta = -.43$, $p < .001$) outcomes. However, contrary to predictions, changes in action planning did not have a statistically significant direct effect on changes in physical activity behaviour (H_{10}).

Indirect effects. The study found a statistically significant indirect effect of changes in action self-efficacy on changes in action planning mediated by intention (H_{11a}, $\beta = .22$, $p = .002$), and a statistically significant indirect effect of changes in action self-efficacy on changes in action planning mediated by changes in maintenance self-efficacy (H_{11b}, $\beta = .26$, $p < .001$). There was a statistically significant indirect effect of changes in action self-efficacy on changes in behaviour mediated by intention (H_{12}, $\beta = .18$, $p = .013$). However, the results from the current sample indicated that a significant indirect effect was not found for changes in

intention on changes in behaviour mediated by changes in action planning, so we rejected H_{13}. There were statistically significant indirect effects of changes in intention on changes in the psychological (H_{14a}, $\beta = -.19$, $p = .041$), body composition (H_{14b}, $\beta = .19$, $p = .042$), and cardiovascular risk (H_{14c}, $\beta = -.22$, $p = .023$) outcomes mediated by changes in behaviour and action planning. Finally, we found no indirect effects of changes in action planning on the psychological, body composition and cardiovascular risk outcome variables mediated by changes in behaviour ($H_{15a\text{-}c}$)[6].

Discussion

The present study tested a model based on the HAPA in which changes in social cognitive constructs with respect to physical activity participation (action and maintenance self-efficacy, outcome expectancies, action planning, risk perceptions, intentions) were proposed to predict changes in body composition (body weight and body fat mass), cardiovascular risk (total cholesterol and low-density lipoprotein) and psychological (quality of life, and depression, anxiety, and stress symptoms) outcomes in overweight and obese adults undergoing a weight-loss intervention. An

[6]We adopted a conventional level of statistical significance ($p < .05$). While each hypothesis can be viewed as an independent test, multiple tests inflate the type I error rate (i.e., finding an effect when no effect exists) due to random chance. Abandoning this level of statistical significance and using a more stringent level (e.g., $p < .005$) to adjust for multiple hypothesis tests would lead to much fewer effects reported as statistically significant. We should, however, also note the effect sizes of the effects affected by increasing the stringency of the alpha level. Effect sizes for the indirect effects of changes in intention on changes in psychological (H14a, Cohen's $f^2 = .05$), body composition (H14b, Cohen's $f^2 = .04$), and cardiovascular risk (H14c, Cohen's $f^2 = .03$) outcomes through changes in behaviour were small, but should be considered non-trivial. According to Kock (2015), "[Effect size] values below .02 suggest effects that are too weak to be considered relevant from a practical point of view" (p. 56), but above the .02 effect size guideline should be considered small but practically important.

important feature of the research is its focus on intra-individual change in constructs over time, while controlling for baseline measures, intervention effects, and sample demographics. The research aims to provide an accurate, ecologically-valid explanation of the dynamic changes that occur in psychological, behavioural, and biomedical outcome variables over time. A further unique contribution is the prediction of change in outcomes that reflect cardiovascular health, weight-loss, and psychological health from the HAPA constructs with intention, action planning, and behaviour as mediators. This is important because it provides an indication as to whether changes in the HAPA constructs evoke a change in outcomes of clinical significance in health contexts mediated by behaviour, an endeavour which is seldom tested in models of this kind. Results supported some key hypothesised relationships consistent with previous research conducted with the HAPA (Barg et al., 2012; Kreausukon, Gellert, Lippke, & Schwarzer, 2012).

The current study revealed a number of pathways to physical activity behaviour and related outcomes that are informative of the processes psychological processes that lead to behaviour. Action self-efficacy was a statistically significant predictor of changes in participants' physical activity intentions and behaviour. Action self-efficacy was also a predictor of action planning through changes in both intentions and maintenance self-efficacy. This points to the pivotal role that action self-efficacy plays in the motivational and volitional phases of the HAPA consistent with previous research (Barg et al., 2012). Participants' confidence in their capacity to engage in the target behaviour may lead to them forming intentions to engage in the behaviour, and, through intentions, engage in actual physical activity behaviour. This effect is consistent with a process outlined in many theories of intentional

behaviour. However, it also seems that such beliefs are also related to the formation of plans to act, through intentions, but also independently through maintenance self-efficacy. This is important as it implicates action self-efficacy in the planning process which mediates the effects of intentions on behaviour, as specified by the HAPA.

A further important finding is the fact that changes in both intentions and action planning were predictors of changes in the outcome variables in the current research. However, changes in action planning were not a mediator of the intention-behaviour relationship as specified by the HAPA. Instead, changes in action planning had effects on changes in the outcome variables independent of changes in behaviour. In this case, changes in action planning were not an intermediate factor implicated in the process by which changes in intentions were converted into action. Instead, it seems that changes in action planning itself was an intermediary by which social cognitive factors like action and maintenance self-efficacy lead to adaptive outcomes, independent of intentions. So this particular finding is contrary to the premises of the HAPA and led us to reject our hypothesis that the intention-behaviour relation is mediated by action planning.

Do these data, therefore, suggest that the HAPA predictions should be rejected? Of course, a single study alone does not provide sufficient evidence to invalidate a model. To speculate, a possible explanation for the current findings is that the physical activity measure did not adequately capture all aspects of physical activity. Perhaps the measure only reflects deliberative forms of physical activity such that two possible pathways to outcomes exist. For some individuals, the planning process is independent of intentions, and may occur after individuals have

consistently performed the behaviour in the past such that the intentional pathway becomes relatively weak, and individuals are more likely to form action plans spontaneously independent of the process of weighing up the benefits and detriments of the course of action as represented by the intentional route. In such cases, behavioural measures that capture more spontaneous forms of activity, rather than the more structured form captured by the current measure, may be more relevant. In contrast, individuals with less experience are more likely to deliberate over their intentions based on their self-efficacy beliefs about the action and this will affect outcomes independent of the route through intentions and behaviour. It may be that action planning is less relevant to such individuals, and other volitional strategies, in measured in the current study, may be more relevant, such as self-monitoring. These speculative accounts notwithstanding, current findings support the pivotal role of self-efficacy in the model and suggest that interventions that aim to change self-efficacy will affect outcomes regardless of whether the route is through the intentional or volitional mediators.

Contrary to our hypotheses, changes in risk perception were not a good predictor of changes in intentions; other studies have also found that this relationship was not statistically significant (Barg et al., 2012; Luszczynska & Schwarzer, 2003; Schwarzer & Renner, 2000). Schwarzer (2008) also noted that risk perception is a distal predictor of intentions and Luszczynska and Schwarzer (2003) state that risk perception may have an influence in the initial consideration of behaviour but may not be as pertinent following the formation of intentions. There is also recent meta-analytic evidence (Peters, Ruiter, & Kok, 2013) and evidence from integrated theoretical models (Hagger et al., 2015) to indicate that perceptions related to threat

do not readily impact on motivation for behaviour change, suggesting that such perceptions do not likely impact on the antecedents of behaviour.

Contribution and Strengths

The current research makes important contributions to knowledge. First, it corroborates prior research that it tests hypotheses from the HAPA and extends these to multiple objectively-measured health-related outcomes as indicators of participation in physical activity. This is seldom done in tests of social cognitive models which generally tend to focus on behavioural prediction alone, and current evidence extend this data to account for the effects of model variables on outcomes of clinical significance mediated by action-related variables. Second, the current research also examines these in light of changes in these variables over the course of a long-term behavioural follow-up, which is relatively rare in research adopting the HAPA and other social cognitive models. This has important implications for supporting the long-term predictive and nomological validity (Cronbach & Meehl, 1955; Hagger & Chatzisarantis, 2012, 2015) of the HAPA and it seems that, the mediation of the intention-behaviour relation by action planning excepted, many of the model predictions appear to hold when examining change over time.

The present research has a number of notable strengths. We had high retention rates with low participant drop-out across the study data collection occasions. A further strength is that the study is one of the first to adopt a well-defined theoretical approach, the HAPA, to identify theory-based predictors and mediators of study outcomes. Adopting this approach permitted the posing of

hypotheses and research questions based on the model and to confirm or reject those hypotheses alongside observation. A major innovation of the present study is the examination of change in the psychological and outcome variables of time, an approach which is in contrast to the typically 'static' perspective adopted in many studies testing social cognitive theories and models in health contexts. For example, many previous tests of such models have focused solely on prediction. The use of residualised change scores for each construct is an important strength of the current study. This enabled us to control for measures of the construct at baseline and week 6 as well as intervention effects, gender, and age so that we tested the unique effects of the HAPA constructs on outcomes.

Limitations

It is also important to acknowledge some of the limitations of the current study. The current study is not a comprehensive test of the HAPA; we omitted the coping planning and recovery self-efficacy variables for reasons of parsimony. In addition, there are some limitations with respect to our measure of physical activity behaviour. The index of physical activity behaviour was derived from participants' responses to self-reported compliance questions in which they self-reported their physical activity compliance based on previous questionnaire measures. Although such measures have been shown to be significantly correlated with more objective measures of physical activity, they may still be subject to respondent bias. The physical activity behaviour variable in the current research should, therefore, be viewed in the context of this limitation.

Another limitation was that some of the measures were self-reported thus subject to social desirability bias. Our adoption of psychometrically-verified, valid measures of the HAPA constructs with explicit instructions for participants to answer candidly and without prejudice were means to allay this bias. In addition, generalisability of the findings to the broader population may be limited. This is because our sample was neither ethnically nor socioeconomically diverse with 75.7% participants classified as White/Caucasian and 75.7% indicating that their highest level of education was at university or tertiary education level. Caution must, therefore, be exercised in generalising results beyond a highly education predominantly White/Caucasian population. In addition, as this investigation was part of a larger intervention, participants completed a number of questionnaires which may have placed undue burden on participants. We managed participant burden by encouraging participants to take regular breaks when completing the intervention materials and measures.

Summary and Conclusion

Overall, results of the current study provide some support for the HAPA in regards to examining changes in the construct variables. However, contrary to the HAPA, changes in action planning did not mediate the intention-behaviour relationship. Instead action planning was an independent predictor of outcomes. Practical recommendations based on findings of the current study are that health behaviour interventions should aim to increase action and maintenance self-efficacy, and action planning as these variables are heavily implicated in the antecedents of

adaptive health outcomes in the current research. This would mean health care professionals that promote self-efficacy (e.g., promoting experiences of success, providing feedback, using modelling and imagery) and better engagement in action planning (e.g., assisting in identifying salient cues, encouraging if-then plans) are likely to be effective in promoting better outcomes in health contexts.

CHAPTER SIX: Predicting Change in Dietary Intake-Related Outcomes in Overweight and Obese Adults Using the Health Action Process Approach

Introduction to Predicting Dietary Intake-Related Outcomes

This chapter provides an overview of a study that tested the Health Action Process Approach (HAPA) in which changes in the model constructs across the study time points predicted changes in dietary intake-related outcomes. The model was tested with respect to variables related to engagement in dietary energy intake restriction in overweight and obese adults who engaged in the HEALTHI program. Dietary intake related outcomes were examined independent of physical activity outcomes due to the large number of analyses required. In addition, the different hypotheses and measures related to the dietary intake outcomes were separate to those used for the physical activity outcomes and were able to be differentiated. This study has been submitted for publication and is currently under peer review. The study examines the predictive value of the HAPA variables on the outcome variables with the model examining the direct relationship between changes in dietary intake planning on changes in the related outcomes variables.

Predicting Change in Dietary Intake-Related Outcomes in Overweight and Obese Adults Using the Health Action Process Approach

Abstract

Purpose. We tested constructs from the Health Action Process Approach (HAPA) model in predicting outcomes related to dietary intake in a sample of overweight and obese adults undergoing a weight-loss intervention.

Methods. Measures of the HAPA constructs (action self-efficacy, outcome expectancies, risk perception, maintenance self-efficacy, intention, and action planning), biomedical outcomes (body fat mass, total cholesterol and low-density lipoprotein), and psychological variables (quality of life, and symptoms of depression, anxiety, and stress, eating behaviour, and nutritional risk) were administered to overweight and obese participants (n = 74) at baseline and week 6 and 12.

Results. A variance-based structural equation model supported our hypotheses based on the HAPA. There were statistically significant direct effects of change in action self-efficacy on change in intention to engage in dietary intake behaviour. Changes in intentions predicted changes in action planning, and changes in action planning predicted changes in each of the biomedical and psychological change outcome variables. Contrary to hypotheses, changes in maintenance self-efficacy did not predict changes in action planning. In addition, changes in outcome expectancies and risk perception did not predict change in intention.

Conclusions. The current study provided support for some of the key hypotheses of the HAPA. In particular, it provided support for the approach in accounting for changes in dietary intake-related outcome variables.

Introduction

Research has indicated that weight-loss reduces incidence of chronic disease risk factors such as type 2 diabetes, coronary heart disease, and cancer in overweight and obese individuals (Blackwell, 2002; Dixon et al., 2003; Hill, 2010; Wing et al., 2011). Weight-loss can be achieved by increasing energy expenditure through physical activity and decreasing energy consumption through food intake (Blackwell, 2002; Wing & Hill, 2001). Research suggests that a reduced calorie diet is effective in achieving weight-loss (Blackwell, 2002). Reducing energy expenditure by 500 calories per day can assist with a weight-loss of approximately 0.5 kilograms per week in most individuals (Fernau, 2010; 2003). Fernau (2010) suggests that a key behaviour that individuals may adopt to manage energy consumption is to count calories. Researchers interested in changing health behaviour have aimed to identify the theory-based psychological factors related to dietary behaviours like calorie counting, and associated health-related outcomes, in order to provide an evidence base to guide the development of effective intervention content. The psychological constructs related to behaviour may be targets for intervention using specific behaviour-change techniques matched to the constructs (Hagger & Luszczynska, 2014; Knäuper et al., 2011).

The present study adopts the Health Action Process Approach (HAPA; Schwarzer, 2008) to identify factors associated with outcomes related to dietary behaviour and weight-loss in overweight and obese individuals. The study will make a novel contribution to knowledge by examining the predictive ability of the HAPA variables in accounting for change in biomedical and psychological outcomes in overweight and obese adults (Hattar et al., 2015). The focus of the current research

on change is important as few studies have accounted for change in predictor and outcome variables in theory-based research examining the psychological predictors of health behaviour (Jacobs et al., 2011). This is an important endeavour in order to move the evidence base for behavioural interventions beyond from the preponderance of static, cross-sectional tests of models like the HAPA in the literature, which the dynamic nature of the models in accounting for processes of change in health behaviour.

Health Action Process Approach

The HAPA provides a framework to understand health behaviour. The model proposes that the change process consists of two phases including: a *motivational* phase, in which an individual forms an intentions to change behaviour, and a *volitional* phase, in which an individual implements their intention to perform the behaviour (Schwarzer, 2008). The model suggests that forming strong intentions to change behaviour does not always lead to behaviour change, referred to as the intention-behaviour 'gap'(Schwarzer, 2008). The model proposes that *intentions* (e.g., an individual's intention to engage in dietary intake behaviour) are related to *planning* (e.g., an individual's plans about when, where and how they would engage in the behaviour), which then impacts on *action*. The motivational phase of the model describes how an individual forms an intention to perform the behaviour or action, with three belief based constructs directly relating to intention formation including: *risk perception* (e.g., perceived risk of developing risk factors related to obesity), *outcome expectancy* (e.g., an individual expectation of the effect that the dietary intake behaviour will have), and *action self-efficacy* (e.g., an individual's

confidence in their ability to engage in the dietary intake behaviour) (Schwarzer & Luszczynska, 2008). Following the individual's intention formation to engage in the behaviour the volitional phase becomes essential to lead to actual behaviour change. Within the volitional phase, both self-efficacy and planning play a critical role. Multiple types of self-efficacy are identified: *action self-efficacy* (motivation an individual has to implement the action), *maintenance self-efficacy* (the individual's beliefs about their ability to deal with potential barriers), and *recovery self-efficacy* (the individual's experience of barriers and belief in their capability to recover) (Schwarzer & Luszczynska, 2008). The model proposes that action self-efficacy has a direct relationship to both intention and maintenance self-efficacy. Also, the model suggests that intentions and maintenance self-efficacy directly relate to planning. Planning is an important step in action formation and is essential to link good intentions to the implementation of actual behaviour.

Research has provided support for the HAPA framework at predicting dietary health behaviours (Chiu, Lynch, Chan, & Rose, 2012; Kreausukon et al., 2012). For example, a study that examined the HAPA in the context of dietary self-management for individuals with multiple sclerosis provided empirical support for the relationships proposed in the HAPA (Chiu et al., 2012). The study found that recovery self-efficacy, and action and coping planning predicted dietary health behaviours. In addition, action self-efficacy, outcome expectancy, and risk perception influenced intention. The researchers also found that action and coping planning mediated the relationship between intention and dietary health behaviours. Also, both direct and indirect relationships were evident between action self-efficacy, maintenance self-efficacy, and recovery self-efficacy on dietary health behaviours.

Similarly, Kreausukon and colleagues (Kreausukon et al., 2012) provided support for the predictive value of the HAPA in the context of dietary health behaviour. The HAPA-based intervention program emphasised perceived dietary self-efficacy and planning skills. Results indicated increased fruit and vegetable consumption among participants in the intervention condition relative to control conditions. Results also indicated that self-efficacy and planning were important predictors of dietary behaviour change. Following this research, the current study examines the effectiveness of the HAPA in accounting for change in dietary intake behaviours. No previous study has investigated the effect of dynamic changes within the HAPA construct variables on multiple behavioural outcomes relating to dietary income and the present study aims to address this gap in the literature.

The Present Study and Hypotheses

This study aimed to examine the HAPA constructs for dietary intake in predicting change in health-related outcomes in overweight and obese adult individuals from baseline to week 6 and 12 undergoing a weight-loss intervention. The relationships hypothesised among the HAPA variables in the present study are summarised in Table 6.1. There is also an accompanying Figure to guide the hypothesised relations among study variables (*see* Appendix X, Figure X1). We have detailed each hypothesised relationship in the next sections using Table 6.1 and Figure X1 as a guide. It is important to note that in the Table and Figure, the constructs reflect a *change* in the construct across study time points.

Table 6.1

Summary of hypothesised direct and indirect effects from the HAPA

H	Independent variable	Dependent variable	Mediator/mediators
H_1	Action self-efficacy	Intention	–
H_2	Intention	Action planning	–
H_3	Action self-efficacy	Maintenance self-efficacy	–
H_4	Maintenance self-efficacy	Action planning	–
H_5	Outcome expectancies	Intention	–
H_6	Risk perception	Intention	–
H_{7a}	Action planning	Body fat mass	–
H_{7b}	Action planning	Cholesterol and low-density lipoprotein	–
H_{7c}	Action planning	Quality of life	–
H_{7d}	Action planning	Depression, anxiety, stress	–
H_{7e}	Action planning	Eating behaviour	–
H_{7f}	Action planning	Nutritional risk	–
H_8	Action self-efficacy	Action planning	Intention
H_9	Action self-efficacy	Action planning	Maintenance self-efficacy
H_{10}	Outcome expectancies	Action planning	Intention
H_{11}	Risk perception	Action planning	Intention
H_{12a}	Intention	Body fat mass	Action planning
H_{12b}	Intention	Cholesterol and low-density lipoprotein	Action planning
H_{12c}	Intention	Quality of life	Action planning
H_{12d}	Intention	Depression, anxiety, stress	Action planning

H_{12e}	Intention	Eating behaviour	Action planning
H_{12f}	Intention	Nutritional risk	Action planning
H_{13a}	Maintenance self-efficacy	Body fat mass	Action planning
H_{13b}	Maintenance self-efficacy	Cholesterol and low-density lipoprotein	Action planning
H_{13c}	Maintenance self-efficacy	Quality of life	Action planning
H_{13d}	Maintenance self-efficacy	Depression, anxiety, stress	Action planning
H_{13e}	Maintenance self-efficacy	Eating behaviour	Action planning
H_{13f}	Maintenance self-efficacy	Nutritional risk	Action planning
H_{14a}	Action self-efficacy	Body fat mass	Maintenance self-efficacy & Action planning
H_{14b}	Action self-efficacy	Cholesterol and low density lipoprotein	Maintenance self-efficacy & Action planning
H_{14c}	Action self-efficacy	Quality of Life	Maintenance self-efficacy & Action planning
H_{14d}	Action self-efficacy	Depression, anxiety, stress	Maintenance self-efficacy & Action planning
H_{14e}	Action self-efficacy	Eating behaviour	Maintenance self-efficacy & Action planning
H_{14f}	Action self-efficacy	Nutritional risk	Maintenance self-efficacy & Action planning
H_{15a}	Action self-efficacy	Body fat mass	Intention & Action planning
H_{15b}	Action self-efficacy	Cholesterol and low-density lipoprotein	Intention & Action planning
H_{15c}	Action self-efficacy	Quality of life	Intention & Action planning
H_{15d}	Action self-efficacy	Depression, anxiety, stress	Intention & Action planning
H_{15e}	Action self-efficacy	Eating behaviour	Intention & Action planning

H_{15f}	Action self-efficacy	Nutritional risk	Intention & Action planning
H_{16a}	Outcome expectancies	Body fat mass	Intention & Action planning
H_{16b}	Outcome expectancies	Cholesterol and low-density lipoprotein	Intention & Action planning
H_{16c}	Outcome expectancies	Quality of life	Intention & Action planning
H_{16d}	Outcome expectancies	Depression, anxiety, stress	Intention & Action planning
H_{16e}	Outcome expectancies	Eating behaviour	Intention & Action planning
H_{16f}	Outcome expectancies	Nutritional risk	Intention & Action planning
H_{17a}	Risk perception	Body fat mass	Intention & Action planning
H_{17b}	Risk perception	Cholesterol and low-density lipoprotein	Intention & Action planning
H_{17c}	Risk perception	Quality of life	Intention & Action planning
H_{17d}	Risk perception	Depression, anxiety, stress	Intention & Action planning
H_{17e}	Risk perception	Eating behaviour	Intention & Action planning
H_{17f}	Risk perception	Nutritional risk	Intention & Action planning
H_{18}	Action self-efficacy	Action planning	Maintenance self-efficacy & Intention
H_{19a}	Action self-efficacy	Body fat mass	[a] Maintenance self-efficacy & Action planning, Intention & Action planning

H_{19b}	Action self-efficacy	Cholesterol and low-density lipoprotein	[a] Maintenance self-efficacy & Action planning, Intention & Action planning
H_{19c}	Action self-efficacy	Quality of life	[a] Maintenance self-efficacy & Action planning, Intention & Action planning
H_{19d}	Action self-efficacy	Depression, anxiety, stress	[a] Maintenance self-efficacy & Action planning, Intention & Action planning
H_{19e}	Action self-efficacy	Eating behaviour	[a] Maintenance self-efficacy & Action planning, Intention & Action planning
H_{19f}	Action self-efficacy	Nutritional risk	[a] Maintenance self-efficacy & Action planning, Intention & Action planning

Note. * Effect comprised of indirect effects with two, three segment pathways of maintenance self-efficacy and action planning, and three segment pathway of intention and action planning.

Direct effects. It was hypothesised that changes in action self-efficacy would predict changes in intention (H_1), and that changes in intention would predict changes in action planning (H_2). Changes in action self-efficacy were predicted to relate to changes in maintenance self-efficacy (H_3), and that changes in maintenance self-efficacy would predict changes in action planning (H_4). It was hypothesised that changes in outcome expectancies (H_5), and risk perception (H_6) would predict changes in intention. We also hypothesised that changes in action planning would mediate changes in each of the biomedical and psychological outcome variables (H_{7a-f}).

Indirect effects. Based on the HAPA predictions, multiple indirect effects in the model were predicted. That is, we hypothesised that changes in action self-efficacy would predict changes in action planning through changes in intention (H_8). Changes in action self-efficacy were also predicted to have an indirect effect on changes in action planning through changes in maintenance self-efficacy (H_9). Changes in outcome-expectancies (H_{10}) and risk perception (H_{11}) were hypothesised to have indirect effects on changes in action planning through changes in intention.

We hypothesised that changes in intention would have an indirect effect on changes in each of the outcome variables through changes in action planning (H_{12a-f}). In addition, changes in maintenance self-efficacy were predicted to have an indirect effect on changes in the outcome variables through changes in action planning (H_{13a-f}). Action self-efficacy changes were also predicted to have indirect effects on changes in the outcome variables through changes in both maintenance self-efficacy and action planning in three-segment indirect effects (H_{14a-f}). We also expected that changes in action self-efficacy (H_{15a-f}), outcome expectancies (H_{16a-f}), and risk perceptions (H_{17a-f}) would have indirect effects on changes in the outcome variables through changes in intention and action planning in three-segment indirect effects. An overall indirect effect of changes in action self-efficacy on changes in action planning through changes in maintenance self-efficacy and intention was also expected (H_{18}). We also hypothesised overall indirect effects of changes in action self-efficacy on changes in each outcome variable through changes in maintenance self-efficacy and action planning, and through changes in intention and action planning, in three-segment indirect effects (H_{19a-f}).

Method

Design. An intervention-controlled three-wave prospective design was used with the variables related to the HAPA constructs (action self-efficacy, outcome expectancies, risk perception, maintenance self-efficacy, intention, and action planning), biomedical (body fat mass, heart pulse, waist circumference, total cholesterol and low-density lipoprotein), and psychological (quality of life, and depression, anxiety, and stress symptoms) outcomes measured at an initial data collection occasion (baseline) and at week 6 and 12. The data used for the study was collected as part of the 12-week Healthy Eating and Active LifesTyle Health Intervention (HEALTHI) intervention study in which overweight and obese participants were randomly-allocated to one of three conditions to promote weight loss: a control condition and two intervention conditions. The program required participants to adhere to guidelines related to dietary intake (consume a calorie intake within their specified minimum and maximum amount) and physical activity (to be physically active, and engage in at least 30 minutes of planned daily exercise). The three intervention conditions varied in content and adopted difference combinations of theory-based health-behaviour change techniques. All participants were provided with weight-loss information, examples of goals related to the dietary intake and physical activity guidelines, and the opportunity to form goals that adhere to these guidelines. Participants in the two intervention conditions received the same information as the control condition, and in addition were asked to form action plans (cue-dependent plans to engage in healthy eating and physical activity) and mental imagery (imagining the steps required to reach their healthy eating and physical activity goals, and imaging having achieved their goal). These intervention

techniques of action planning and mental imagery aimed to target changes in the HAPA constructs of action planning and self-efficacy respectively. Participants from one of the intervention conditions also received goal-reminder text messages aimed to increase adherence to the planning and imagery exercises. The full study protocol for the intervention is provided in an independent article outlining the intervention content, study design, and method (Hattar et al., 2015). Results revealed no effects of the intervention conditions on behavioural, biomedical, and psychological outcomes, although there were changes over time for all conditions. In the current study, we controlled for intervention effects in order to negate any potentially confounding effects of the intervention. The trial was registered on the Australia and New Zealand Clinical Trials Registry (Trial registration number ACTRN12613001274763) and received ethical approval from the Curtin University Human Research Ethics Committee.

Participants. A community sample of overweight or obese adults (*N* = 74*; M* age = 41.10 years, *SD* = 12.10; Body Mass Index = 31.13, *SD* = 3.55) from Curtin University that met study inclusion criteria were randomly assigned to one of the three intervention conditions. The inclusion criteria were: aged between 18 and 65 years, overweight or obese with a body mass index between 25 and 40, and willingness to have blood samples taken. The exclusion criteria were: serious health conditions, pregnancy, and severe depression. The study protocol (Hattar et al., 2015) provides a comprehensive list of the inclusion and exclusion criteria. In all conditions participants were provided with a psycho-education session and instructed to set weight-loss goals and were given information on how to exercise and count calories to achieve this goal.

Measures

Health Action Process Approach constructs. We included measures of the HAPA variables (risk perception, outcome expectancy, action self-efficacy, maintenance self-efficacy, intention, and action planning) with respect to weight-loss and dietary intake at baseline and at week 6 and 12 post-intervention. Measures were adapted from Barg and colleagues' (2012) article. The items are outlined in Appendix Y (*see* Table Y1).

Biomedical outcome variables. The biomedical outcome variables were collected at baseline, week 6 and 12 unless specified otherwise. Total body fat in grams was measured at baseline and week 12 using a whole body dual-energy X-ray absorptiometry (DEXA, Lunar Prodigy; Lunar, Madison, WI, USA) apparatus; the DEXA apparatus underwent daily calibration and phantom scans. A venous blood sample was taken at an approved pathology laboratory (within approximately three days prior to the clinic appointment) provided measures of Total cholesterol (TC) and low-density lipoprotein (LDL).

Psychological outcome variables. Psychological outcome variables were measured at baseline, week 6 and 12. We measured quality of life using the 31-item Impact of Weight on Quality of Life Questionnaire or IWQOL – Lite (Kolotkin & Crosby, 2002) with responses provided on five-point scales ranging from 1 (never true) to 5 (always true) to assess the effect of obesity on quality of life. Symptoms of depression, anxiety, and stress were measured using the 21-item Depression Anxiety Stress Scales-21 (Lovibond & Lovibond, 1995) with participants rating symptoms over the past week on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). Nutritional risk was assessed

using the 24-item Bailey Dietary Screening Questionnaire, with participants responding to items (e.g., “how often do you usually eat fruit as a snack?”) using a 4-point Likert scale ranging from 0 (never) to 4 (3 or more times a week) (Bailey et al., 2009). In addition, eating behaviour was assessed using the 18-item Three Factor Eating Questionnaire to measure three domains of eating behaviour including cognitive restraint, uncontrolled eating, and emotional eating with responses to items (e.g., “I start to eat when I feel anxious”) made on four-point scales ranging from 1 (definitely true) to 4 (definitely false) (Cappelleri et al., 2009).

Statistical analysis

Participant attrition. Seventy five participants took part in the HEALTHI program. Data for one participant was excluded from the analysis because their BMI fell below the inclusion criterion of 25, leading to 74 data sets remaining for use in the analysis. High participant retention rates were evident throughout the intervention with four participants dropping out at the 6-week follow-up appointment, and three dropping out at the 12-week follow-up appointment. A full intention-to-treat analysis was conducted, with the last measurement data point carried forward; this technique provides a conservative estimate of the hypothesised effects.

Analyses. Study hypotheses were tested in a variance-based structural equation model (VB-SEM) using computed unstandardised residualised change scores for each variable. Unstandardised residualised change scores were calculated for all the models variables including the HAPA constructs and behaviour-change outcome variables. The change scores were computed by regressing post-intervention scores for study variables onto baseline measures. The change scores

controlled for intervention condition, and participants' age and gender by incorporating these as control variables in the regression equations. For each variable the change scores at week 12 also controlled for both the baseline and week 6 score. The only exception was body fat mass as this was only measured at baseline and week 12 to limit unnecessary exposure to the minimal amount of radiation from the use of the DEXA apparatus. The Warp PLS v.5.0 statistical software (Kock, 2015) was used to perform the VB-SEM analysis. This method uses ranked data thus reducing outlier value distances. In comparison with covariance-based SEM methods, VB-SEM analysis is less affected by small sample size, model complexity, and data non-normality. A bootstrapped resampling method with 100 resamples was used to estimate the effects (Kock, 2015). Ringle, Sarstedt, and Straub (Ringle et al., 2012) state that partial least squares structural equation modelling methods are criticised due to small sample sizes without power analyses support; the authors suggest that for PLS-SEM researchers can provide support for sample sizes using the power tables from regression (J. Cohen, 1992) to determine the minimum sample size needed for power (Chin, 2010). The sample size was determined in the present study by using a power analysis for multiple regression with three predictor variables which is the most complex regression system within the model; the statistical power was set at .80, alpha level set at .05, and a moderate effect size; previous predictive studies using the HAPA revealed a moderate effect size (Barg, 2010). The sample size calculation revealed that 73 participants is sufficient for power; the present study examined data from a sample size of 74 participants.

Results. Latent variable correlations and composite reliability coefficients constructs included in the VB-SEM model are displayed in Table 6.2.

Table 6.2

Latent factor correlations and R^2 statistics for variables included in the proposed variance-based structural equation model

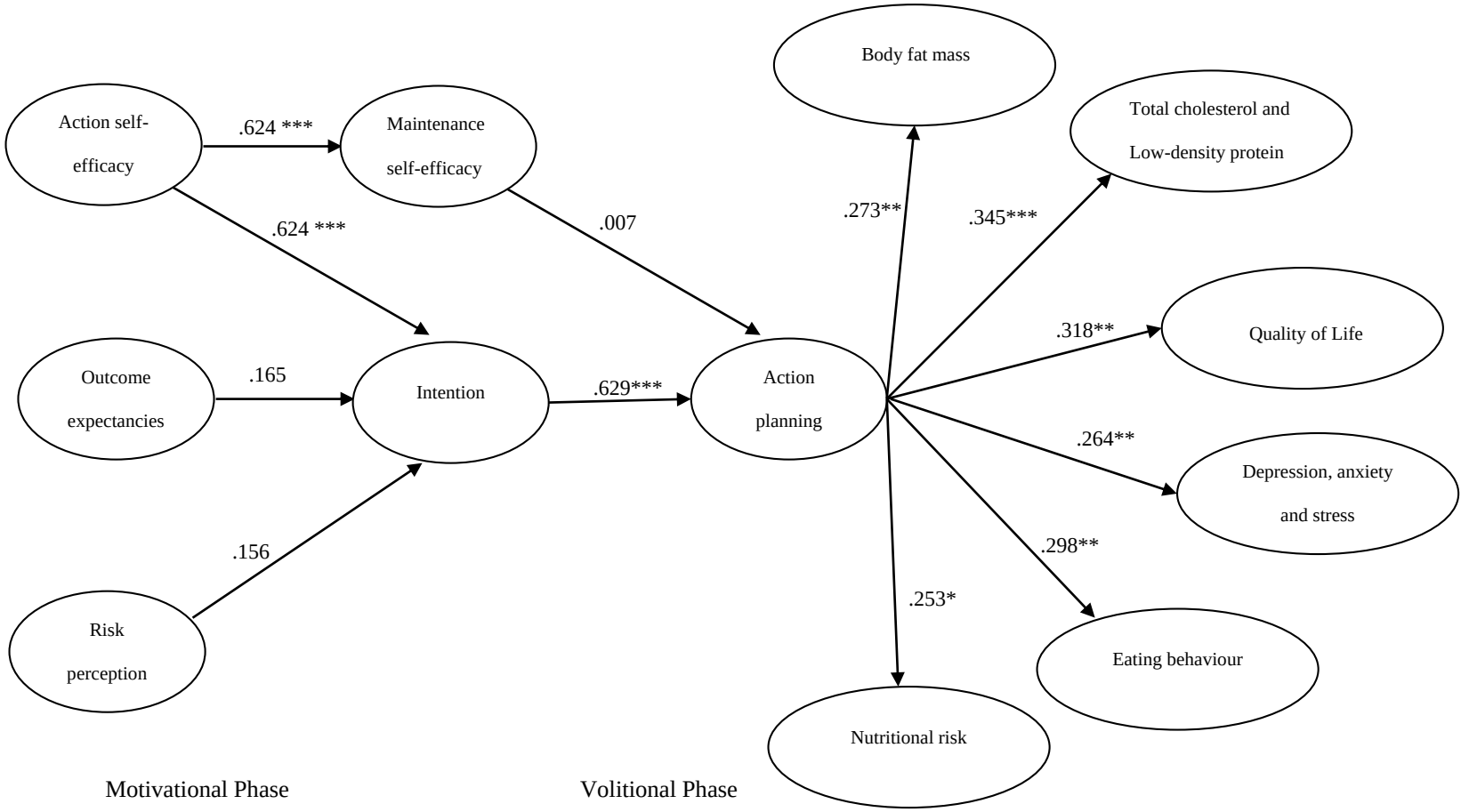
Variable	R^2	1	2	3	4	5	6	7	8	9	10	11
1. Action self-efficacy	–	–										
2. Outcome expectancies	–	0.181	–									
3. Risk perception	–	-0.042	-0.038	–								
4. Maintenance self-efficacy	0.390	0.619***	0.058	-0.147	–							
5. Intention	0.463	0.599***	-0.100	-0.103	0.615***	–						
6. Action planning	0.396	0.580***	0.051	0.007	0.363**	0.616***	–					
7. Body fat mass	0.074	-0.153	-0.201	0.228	-0.206	-0.231*	-0.187	–				
8. Cholesterol and low-density lipoprotein	0.119	-0.180	-0.019	-0.042	-0.142	-0.298*	-0.334**	0.303**	–			
9. Quality of life	0.101	0.020	0.070	0.239*	-0.162	-0.186	-0.127	0.364**	0.066	–		
10. Depression, anxiety and stress	0.070	0.035	0.024	0.046	-0.064	-0.067	0.090	0.135	0.002	0.236*	–	
11. Eating behaviour	0.089	-0.245*	-0.217	0.333**	-0.354**	-0.239*	-0.062	0.460***	0.052***	0.189	0.162	–
12. Nutritional risk	0.064	0.072	-0.105	0.074	0.236*	0.264*	0.220	-0.167	-0.167	-0.143	-0.008	-0.174

Note. R^2 = variance accounted for in the VB-SEM model's dependent variable; α = variable alpha reliability estimate *p* *<.05. **<.01. ***<.001.

Composite reliability coefficients suggest the latent variables within this study had satisfactory reliability. Also, the VB-SEM demonstrated the data had adequate model fit based on multiple recommended indices with large effect sizes (Kock, 2015). The average path coefficient (APC) and average R^2 (ARS) indices values were found to be significant with the *p*-value equal to or lower than .05, (APC = 0.328, $p < .001$; ARS = 0.185, $p = .024$), indicating adequate model fit. In addition, the Tenenhaus Goodness-of-Fit (GOF = 0.400) value exceeded the 0.36 cut-off indicating that the model had large explanatory power. The average full collinearity VIF (AFVIF) demonstrated that the model's overall predictive and explanatory quality was adequate with the value below the proposed cut-off value of 3.3 (AFVIF = 1.664), (Kock, 2015). Hypothesised relationships among constructs from the HAPA are illustrated in Figure X1 (*see* Appendix X). The model's outcome variables beta and correlation indexes are displayed in Figure 6.1. For clarity, parameter estimates for paths not depicted in Figure 6.1 are provided in Figure Z1 (*see* Appendix Z). Below are results from our tests of hypotheses from the HAPA.

Direct effects. The beta coefficients correlation indexes for each of the hypothesised direct effects outlined in Figure X1 are discussed. As hypothesised, a statistically significant direct effect of changes in action self-efficacy was found to effect changes in intention (H_1, $\beta = .642$, $p < .001$), and changes in intention was found to predict changes in action planning (H_2, $\beta = .629$, $p < .001$). A statistically significant direct effect of changes in action self-efficacy on changes in maintenance self-efficacy was also found (H_3, $\beta = .624$, $p < .001$). However; contrary to predictions, changes in maintenance self-efficacy did not predict changes in action planning, therefore hypothesis H_4 was rejected. In addition, there were no

Figure 6.1. Structural Equation Model's Standardised Path Coefficients of the Hypothesised Relations among Model Constructs.



Note. p *<.05. **<.01. ***<.001.

statistically significant direct effects of changes in outcome expectancies on changes in intention, and changes in risk perception on changes in intentions, so we rejected hypotheses H_5 and H_6 accordingly. Finally, we found statistically significant effects of changes in action planning on changes in body fat mass (H_{7a}, $\beta = -.273$, $p = .006$), total cholesterol and low-density lipoprotein (H_{7b}, $\beta = -.345$, $p < .001$), quality of life (H_{7c}, $\beta = -.318$, $p = .002$), depression, anxiety and stress symptoms (H_{7d}, $\beta = .264$, $p = .008$), eating behaviour (H_{7e}, $\beta = -.298$, $p = .003$), and nutritional risk (H_{7f}, $\beta = .253$, $p = .011$).

Indirect effects. We found a statistically significant indirect effect of changes in action self-efficacy on changes in action planning through changes in intentions (H_8, $\beta = .401$, $p < .001$). In addition, changes in action self-efficacy had a statistically significant indirect effect on changes in action planning through changes in maintenance self-efficacy (H_9, $\beta = .243$, $p = .001$). Contrary to the predictions, no statistically significant indirect effects were found from changes in outcome expectancies on changes in action planning through changes in intention (H_{10}), or from changes in risk perception on changes in action planning through changes in intention (H_{11}). Changes in intention had a statistically significant indirect effect on changes in body fat mass (H_{12a}, $\beta = -.172$, $p = .015$), total cholesterol and low-density lipoprotein (H_{12b}, $\beta = -.217$, $p = .003$), quality of life (H_{12c}, $\beta = -.200$, $p = .006$), depression, anxiety and stress symptoms (H_{12d}, $\beta = .166$, $p = .018$), eating behaviour (H_{12e}, $\beta = -.188$, $p = .009$), and nutritional risk (H_{12f}, $\beta = .159$, $p = .023$) through changes in action planning. Contrary to our hypotheses (H_{13a-g}), there were no significant indirect effects of changes in maintenance self-efficacy on changes in any of the outcome variables through changes in action planning. Also, there was no

statistically significant effect of changes in action self-efficacy on changes in the outcome variables through changes in maintenance self-efficacy and action planning in three-segment indirect effects, so we rejected our hypotheses (H_{14a-g}). We found a statistically significant indirect effect of changes in action self-efficacy on changes in body fat mass (H_{15a}, $\beta = -.110$, $p = .048$), total cholesterol and low-density lipoprotein (H_{15b}, $\beta = -.139$, $p = .017$), quality of life (H_{15c}, $\beta = -.128$, $p = .026$), and eating behaviour ($H_{15e,}$ $\beta = -.120$, $p = .034$), through changes in intentions and action planning in three-segment indirect effects. Indirect effects of depression, anxiety and stress symptoms, and nutritional risk were not statistically significant, so we rejected H_{15d} and H_{15f}. In addition, no statistically significant indirect effects were observed for changes in outcome expectancies and changes in risk perceptions on the outcome variables through changes in intentions and action planning within three-segment indirect effects, so we rejected our hypotheses (H_{16a-g} and H_{17a-g}). Results revealed that the overall indirect effect of action self-efficacy changes on action planning changes, through changes in both maintenance self-efficacy and intentions, were statistically significant ($H_{18,}$ $\beta = .409$, $p < .001$). In addition, overall indirect effects of changes in action self-efficacy on changes in the outcome variables through multiple paths were not statistically significant leading us to reject our hypotheses (H_{19a-g}).

Discussion

The current study found support for effects of changes in social cognitive variables from the HAPA (action self-efficacy, outcome expectancies, risk perception, maintenance self-efficacy, intention, and action planning) for dietary intake on changes in biomedical (body fat mass, total cholesterol and low-density

lipoprotein) and psychological (quality of life, and symptoms of depression, anxiety, and stress, eating behaviour, and nutritional risk) outcomes in a sample of overweight and obese adults undertaking a weight-loss intervention. Results supported some key hypotheses relating to the HAPA. Changes in action self-efficacy on changes in intention to engage in dietary intake behaviour was found to be statistically significant consistent with previous research (Barg et al., 2012) based on the HAPA. This finding indicates that participants' self-efficacy in their ability to engage in dietary intake behaviours is strongly related to intention to change dietary intake, which according to the HAPA, is a key antecedent of actual behaviour. Importantly, changes in intentions predicted changes in action planning, with changes in action planning predicting changes in each of the biomedical and psychological outcome variables. This finding suggests that participants' intentions to engage in the dietary intake behaviour may play an important role in influencing plans to engage in dieting behaviours. In addition, participants planning their diet had better biomedical and psychological outcomes consistent with our expectation that planning to engage in dietary intake behaviours may lead to a greater likelihood of implementing behaviour change and hence influencing behaviour-related outcomes.

Contrary to hypotheses, changes in maintenance self-efficacy did not predict changes in action planning and, as a consequence, any of the outcome variables. This finding is in contrast to other research (Barg et al., 2012) which found maintenance self-efficacy to be a significant predictor of planning. This unexpected finding is particularly relevant given that the focus of the current research was on changes in social cognitive and outcome variables, which should be a better indication of maintenance of behaviours. The lack of predictions could suggest that confidence in

one's ability to engage in the dietary intake behaviour when faced with barriers did not affect planning ability within the current sample. Alternatively, the reasons for the lack of prediction could be attributed to the measurement and conceptualisation of the maintenance self-efficacy variable. The variable made reference to salient barriers and confidence perceptions for overcoming the barriers. The list of barriers was imposed by the researchers and, although based on previous research, may have not been relevant or applicable to all participants introducing sufficient measurement variance that may have affected its predictive validity. We also found that outcome expectancies were also not a statistically significant predictor of changes in action planning or outcome variables. This is consistent with other studies have found that risk perceptions did not predict intentions (Barg et al., 2012; Luszczynska & Schwarzer, 2003; Schwarzer & Renner, 2000). Luszczynska and Schwarzer (2003) reported that risk perception may initially influence behaviour; however following intention-formation it may no longer be as relevant. This explanation is very pertinent to the current study and its focus on changes in the dependent variables and outcomes in the HAPA rather than prediction alone. The focus on change is important because it controls for variation in constructs over time and provides a better account for effects in a model, as it accounts for random variation in the constructs over time and accounts for dynamic influences on model constructs.

Strengths and Limitations. The current research study had a number of strengths. An important strength is the participant drop-out rate which was kept to a minimum over the course of the study data collection points. High retention rates may have been due to participants with high extant motivation to change their behaviour volunteering to participate in the trial, a key issue for all intervention

trials. In addition, high retention rates could be due to the high accessibility and clarity of the weight-loss intervention with two guidelines for physical activity (to engage in a minimum of 30 minutes of daily exercise, and to remain physically active), and one guideline for dietary intake (for calorie intake to range between their minimum and maximum calorie amount). It might also have been due to highly pro-active contact with participants to encourage attendance by the research team. A further important contribution is the adoption of a relevant social cognitive approach in the HAPA, the focus on explaining change in the model variables from baseline to week 12, and the inclusion of a control for baseline and week 6 responses, gender, age and intervention condition allocation. The focus on change is an advance on many previous models that have focused on static prediction of model variables and relevant outcomes at a given point in time. Individuals do not act in a 'behavioural vacuum,' new information comes to light which may lead individuals to modify or change their beliefs, processes that are not captured by cross-sectional research that does not model change. If the predictors of the model hold when controlling for change, then researchers can be more confident that the model predictions hold under conditions of dynamic change and that naturally occurring fluctuations in model variables do not affect model validity.

It is also important to note study limitations. The HAPA and psychological variables were self-report measures which may have introduced an element of measurement error. For example, individuals' recall of their dietary behaviour and social cognitive perceptions may have been limited or they may have been subject to social desirability despite our use of rigorous, previously-validated measures to minimise response bias. In addition, some of the HAPA variables were not measured

such as coping planning and recovery self-efficacy, which means our test was not of the complete model. Further, despite efforts to recruit a participant sample from diverse backgrounds, 75.7% of participants were of White/Caucasian ethnicity and 75.7% had a university or tertiary-level education thus limiting the generalisability of the study results. In addition, consistent with many studies in this area, participants were self-nominated and were therefore likely to be motivated to engage in the study, which may have limited the generalisability of results.

CHAPTER SEVEN: Discussion

Executive Summary

The purpose of the research reported in this thesis was to develop and evaluate the HEALTHI program, and to test the predictions of the HAPA model within the context of dietary intake and physical activity behaviour. The HEALTHI program, a brief, low-cost, weight-loss intervention based on psychological theory, was developed in order to improve dietary intake and physical activity behaviour and promote adaptive change in biomedical, psychological and behavioural outcomes in overweight and obese individuals using a theory-based model. The 12-week HEALTHI program examined the use of the two theory-based intervention techniques of mental imagery and implementation intentions. In addition, the intervention evaluated whether mobile phone text messages will augment the interventions effectiveness. The program was based on the HAPA and on previous research that supported the combination of implementation intention and mental imagery to assist with the improvement of behavioural outcomes in health-related intervention studies (Andersson & Moss, 2011; Knäuper et al., 2011; Knäuper et al., 2009). In addition, research has found support for the use of text messages to improve compliance with health goals (Haapala et al., 2009; Patrick et al., 2009; Prestwich, 2009; Prestwich et al., 2010). The current research also aimed to predict changes in biomedical, psychological and behavioural outcome variables based on changes in the HAPA variables over the course of the intervention. The significance of this intervention is that health professionals may have a means of assisting overweight and obese individuals with weight-loss assistance through providing

them with a copy of the evidence based self-help video intervention program to view at a time and location of their convenience. This may reduce reliance on health professionals and also save costs of care and time.

Overview of findings related to the effects of the HEALTHI program.

The first step in the research was to review the theoretical framework that guided the research (Chapter 1), and the development of the HEALTHI program informed by data from focus group sessions, previous interventions, and theory (Chapter 2). Based on results from Chapter 2, the intervention study protocol was finalised (Chapter 3). The HEALTHI program study intervention effects were examined (Chapter 4). Contrary to hypotheses the two intervention conditions did not lead to statistically-significant changes in the primary and secondary outcome variables in participants relative to participants who received the psycho-education control condition. Although the intervention effects were not statistically significant, the study found some effects of time of measurement, on some of the outcome variables indicating adaptive changes in key outcomes related to cardiovascular health and reduced risk of chronic conditions in all intervention conditions, including the psycho-education control condition. Therefore, despite no intervention, or intervention by time of measurement interaction effects, results may support the benefits of the HEALTHI program weight-loss intervention to assist overweight and obese individuals to improve on targeted outcome variables. The lack of effects within the two intervention conditions in comparison to the control condition, may be due to the psycho-education information provided to participants within all intervention conditions. The control condition included goal setting as a component which may have been sufficient to change behaviour in all conditions such that the

additional components in the two intervention conditions (implementation intentions, mental imagery, and goal-reminder text messages) did not result in any greater engagement in the health behaviours or target post-intervention relative to the control condition. Information provided to all participants included: demonstration on healthy eating (including calorie counting), physical activity, examples on how to engage in these health behaviours, and formulating goals on how to achieve the guidelines on dietary intake and physical activity behaviour. The study results provide some indication that these components alone may be effective in assisting overweight or obese individuals to change dietary intake and physical activity behaviour to lead to weight-loss and reduction of obesity-related risk factors. However, we cannot ascertain these conclusions without further examination of whether the additional components included in the psycho-education control condition resulted in changes in the outcome variables relative to a condition on which participants received no intervention.

Previous research has indicated that health-behaviour change occurs in interventions adopting the same components as those used in the psycho-education condition in the current study. Self-monitoring of behaviour allows an individual to pay attention to and record aspects of their behaviour, therefore may assist in the process of facilitating behaviour-change (Burke et al., 2011). A systematic review of behavioural weight-loss studies involving self-monitoring of diet, exercise, and self-weighing behaviour found support for the importance of the relationship between weight-loss due to the process of self-monitoring (Burke et al., 2011). Within the systematic review, self-monitoring was defined in accordance with Foster, Makris, and Bailer (2005) as recording dietary intake and physical activity behaviour to

provide an individual with increased awareness of their behaviour. The current intervention techniques to promote self-monitoring such as recording and monitoring physical activity levels and calorie consumption. These techniques may have increased participants' awareness of their behaviour. In addition, self-regulatory theory suggests that goal progress evaluation and positive reinforcement of the behaviour due to the progress made is a consequence of self-monitoring (Kanfer, 1991). According to social cognitive theory, the formulation of achievable goals can lead to increased self-efficacy and therefore behaviour-change (Bandura, 1991). Self-efficacy may also increase as a result of the intervention's provision of examples of exercise engagement and healthy eating which promote feedback. The current intervention used goal formulation across all intervention conditions which may have been sufficient to change behaviour in all conditions such that the additional components provided to the two intervention conditions (implementation intentions, mental imagery, and goal-reminder text messages) did not result in health-behaviour changes relative to the control condition.

Overview of findings related to the HAPA model with the outcomes.

Another important step in the research involved exploration of change within the HAPA variables to evoke change in some of the outcome variables related to weight-loss; this was explored in relation to physical activity (Chapter 5) and dietary intake (Chapter 6). HAPA variables and behaviour-related outcomes were examined using an overweight or obese adult sample who participated in the HEALTHI program. The studies provided some support for the use of the HAPA variables to predict changes in physical activity and dietary intake-related outcomes within the context of the HEALTHI program.

The predictive studies confirmed some key hypothesis relating to the HAPA, consistent with previous research that adopted the HAPA (Barg et al., 2012; Kreausukon et al., 2012). Changes in participants' action self-efficacy predicted changes in intention to engage in the health behaviours consistent with other studies (Barg et al., 2012). These findings imply that changes in a participants' confidence and belief in their ability to participate in the health behaviour is associated with change in their intentions to engage in the behaviour. Support for change in intentions in predicting change in action planning was also found. In addition, change in action planning was found to predict changes in the outcome variables.

Both predictive studies found that changes in action self-efficacy predicted changes in maintenance self-efficacy, however only the physical activity model found support for the relationship between maintenance self-efficacy and action planning in contrast with previous research (Barg et al., 2012) and the proposals of the HAPA. However; the conflicting finding within the dietary intake model is important as the study aimed to examine changes in social cognitive and outcome variables; the lack of prediction may be due to error in the measurement and conceptualisation of the maintenance self-efficacy variable. That is, the variable made reference to salient barriers and confidence perceptions to overcome a specific list of barriers. The list of barriers was imposed by the researcher based on previous research, and may not have been relevant to the participants. If so, then this variable may not have aligned closely with individual's action plans as predicted due to a lack of correspondence. Alternatively, the lack of prediction of maintenance self-efficacy on planning in the dietary intake model could reflect that confidence in one's ability to implement the dietary intake behaviour when confronted by barriers, did not affect

planning ability within the current sample. This may provide some preliminary evidence to raise questions over key predictions of the HAPA. However, given the limitations of the current study, concluding that the predictions of the HAPA were invalid based on the current data alone would be speculative and premature.

The studies found that contrary to HAPA hypotheses, changes in risk perception was not a good predictor of changes in intentions; previous studies have also found this relationship to be statistically non-significant (Barg et al., 2012; Luszczynska & Schwarzer, 2003; Schwarzer & Renner, 2000). Future research may consider the predictive ability of risk perception and the role it has within the HAPA model. Luszczynska and Schwarzer (2003) reported that risk perception may initially influence behaviour, however after the intention has been formed it may no longer be relevant. As outlined the predictive studies were able to predict changes in some key variables within the HAPA on changes within the outcome variables.

Importantly, participants who planned engagement in the health behaviour had improved scores on the outcome variables. However; action planning did not significantly lead to greater prospect of actual physical activity behaviour change. Instead, intention to engage in physical activity behaviour was directly related to the behaviour, and behaviour led to improvements in outcome variables. This finding highlights that action planning did not mediate the relationship between intention and behaviour, which is contrary to the HAPA. In addition, the results indicated that physical activity action planning may be an independent predictor of change in outcome variables. When examining the dietary intake HAPA variables on related outcome variables, the results also indicated that action planning was a predictor of change in the outcome variables. The findings suggest that change in physical

activity action planning was not an intermediate factor implicated in the process by which changes in intentions were converted into action. Instead, it appeared that changes in physical activity action planning itself was an intermediary by which social cognitive factors like action and maintenance self-efficacy lead to adaptive outcomes, independent of intentions. This finding was contrary to the premises of the HAPA as the intention-behaviour relation was not found to be mediated by action planning. However, a single study on the HAPA model in the context of physical activity does not provide sufficient evidence to invalidate the model. To speculate, a possible explanation of the findings could be that the self-report physical activity measure may not have been valid due to reporting bias. Alternatively, the absence of the mediation of the intention-behaviour relation by action planning could indicate that planning does not function so as to explain the link between intentions and behaviour, which is contrary to predictions of the HAPA, but consistent with theories of intention. Planning may serve as a moderator of the intention-behaviour relationship consistent with the model of action phases (Heckhausen & Gollwitzer, 1987).

Study Strengths

The current research has notable strengths. The study examined the use of multiple behaviour-change techniques in the development of a weight-loss program that is low-cost and theory-based providing practical opportunity for its use in the health setting. As the psycho-education weight-loss condition was found to evoke the changes of the intervention conditions, this highlights the importance of the components used in this condition including goal setting and self-monitoring to facilitate change in health behaviour and reduce obesity-related risk factors in

weight-loss interventions. In addition, the online delivery method and its low cost is a strength of the HEALTHI program that may appeal to health professionals to prescribe the program to overweight and obese individuals who require weight-loss. Another notable strength is that the study corroborates prior research related to the HAPA and extends to them through the use of multiple objectively-measured health-related outcomes associated with physical activity and dietary intake behaviour. In addition, the study had high retention rates with low participant drop-out over the course of the study data collection points which is ideal and therefore a strength of the study.

In addition, a further strength of the current research is that it permitted a test of the efficacy of constructs from the HAPA, a well-defined theoretical approach, as predictors of change in multiple biomedical, psychological and behavioural outcome variables. In addition, the use of residualised change scores for the HAPA variables controlled for participants' responses to the variables at baseline and week 6, as well as age, gender, and the condition allocation is a notable strength. This is important, as neglecting to control for these variables may misrepresent the effects of the HAPA constructs on study outcomes. In addition, as these and the intervention effect studies examined the health-related outcomes in light of changes in the variables over a 12-week follow-up period, the data assisted in providing support with long-term predictive and nomological validity of the HAPA. In addition, examining change in variables (HAPA and outcome variables over time) is an important contribution to many previous models that have concentrated on static prediction of model variables and the relevant outcomes at the time point. By predicting change in the psychological variables it provided the researchers with an indication of whether the

HAPA is able to explain the dynamic nature of the participants' beliefs in relation to further commitment in the behaviour. Examining model changes takes into account possible changes in an individual's beliefs, which is a process that cross-sectional research is unable to account for.

Study Limitations

It is important to highlight the limitations of the current research. One limitation is that participants within the weight-loss psycho-education weight-loss condition were prompted to set physical activity and dietary intake goals, and hence received access to the strategy of goal setting. It was anticipated that the intervention components including mental imagery, implementation intentions or action planning, and text messages would lead to greater physical activity and dietary intake engagement beyond the goal setting and educational component of the intervention. The goal setting and educational components accessed by the psycho-education weight-loss condition were probably sufficiently strong to lead to changes, and the other intervention components (mental imagery, implementation intentions, and text messages) did not result in greater behaviour change by comparison. However; we cannot unequivocally ascertain that this was the case, and a non-intervention or minimal intervention control condition would be necessary to provide further corroborating evidence; such a study design would allow us to evaluate whether the psycho-educational components common to all intervention conditions were responsible for the observed changes in behaviour over the intervention time points.

In addition, despite the researcher's efforts to recruit participants external to Curtin University, the majority of participants were recruited from within the

university and the majority of participants were university staff. This may lead to generalisability issues and limit the extent to which the current findings can be mapped onto a wider population of overweight and obese individuals. In addition, the sample was not socioeconomically or ethnically diverse: 75.7% participants classified as White/Caucasian and 75.7% indicated their highest level of education was university or tertiary education level. Caution is therefore required when generalising the study results beyond a highly educated, predominately White/Caucasian population. Another limitation consistent with many studies is that study participation was voluntary and individuals self-nominated to engage in the weight-loss intervention and therefore are likely to be motivated which may impact the generalisability of the results. The lack of a non-intervention control condition did not allow to ascertain whether the changes observed in the current intervention were due to the psycho-educational components common to all conditions.

In addition, the psychological and behavioural measures were self-reported and may have been subject to social desirability. In an attempt to allay this bias, the use of psychometrically-verified, valid measures of the constructs with explicit instructions were used to assist participants to answer items honestly and without preconception. In addition, due to the use of self-reported measures to examine the study constructs there is also potential for the relation between variables being inflated due to the common method variance or variance attributed to the measurement method. Participant burden due to the requirement for participants to complete a large number of questionnaires was another potential limitation. In an attempt to manage participant burden, the researchers encouraged participants to

have regular breaks during the completion of the intervention materials and measures.

Turning to limitations related to the prediction analyses (Chapters 5 and 6), which were the studies that examined the efficacy of HAPA constructs in predicting biomedical and psychological change outcomes related to physical activity and dietary intake within the adult sample that underwent the HEALTHI weight-loss program. A limitation is that the studies did not provide a comprehensive test of the HAPA, as the variables of coping planning and recovery self-efficacy variables were omitted for parsimony reasons. The need to limit the number of measures included in the study was important to manage participant burden associated with completing a large number of questionnaires, limit cost and resources, and to effectively manage participants' time.

Future Directions

Future direction for research. Future directions for research include the inclusion of a non-intervention control condition such as a wait-list control condition in addition to the psycho-education weight-loss condition. The benefits of including a non-intervention control condition would be to have a group of participants who have not received any form of intervention such as access to the psycho-education material and goal setting information. Such study designs would allow the researchers to distinguish between the psycho-education weight-loss and intervention conditions. In addition, the current study combined the strategies of mental imagery and implementation intention within the intervention conditions based on research that suggests the two techniques will operate "synergistically." However, future

research may alter the study design to examine the individual effects from each of the strategies separately, in comparison to the effects from the combination of the two strategies. Future research in this area may benefit from having a more diverse sample to examine the application of the current results within a different community population. Future research may also benefit from the inclusion of all the HAPA variables to provide a more comprehensive test of the HAPA and its application in examination of the health behaviours and change in the outcome variables. The use of alternative measures may also be beneficial to reduce social desirability issues related to self-reported measures.

When testing the HAPA in predicting changes in outcome variables with respect to physical activity participation null effects for changes in planning on changes in behaviour were found which contradicts the study hypothesis based on the HAPA. Previous studies using this theoretical approach found that action planning mediated the relationship between intentions and physical activity behaviour (Conner & Norman, 2005; Norman & Conner, 2005). However, the current studies lack of findings for intervention effects is not in isolation. Other studies have also found null effects of action planning or implementation intentions, and mental stimulations on behaviour change (Jackson et al., 2005; Koka & Hagger, in press; Parschau et al., 2014). An understanding of the reasons behind the current studies null intervention effects compared to studies that have found the intervention effects is unknown. A systematic review of the research literature to explore the differences among studies would be beneficial. Such research may identify whether there are any fundamental differences between studies that have found intervention effects versus lack of effects. Future research may also compare studies that used a

traditional control condition that consists of no planning or intervention component versus a comparison condition such as that used within the current study.

Future directions for practice. Future directions for practice include acknowledgement of the importance of goal setting and self-monitoring of calorie counting as the common component in all three conditions, as were the instructions on how to engage in the dietary intake and physical activity behaviours which may have been responsible for the behaviour-change. These components were not specifically hypothesised from the onset of the study, however emerged as a results of the study findings that examined the HEALTHI program intervention effects. Research has found support for the benefits of self-monitoring behaviour in the area of dietary intake and physical activity (Burke et al., 2008; Burke et al., 2011), and goal setting (Bandura, 1991; Kanfer, 1991) to evoke health-behaviour change.

The current study suggests that strategies to improve self-efficacy and action planning seem to be important in determining changes in outcomes based on the HAPA model. For this reason, practical recommendations based on these findings is for health behaviour interventions or health professionals to promote action self-efficacy and action planning to lead to biomedical and psychological changes. That is, health care professionals are encouraged to promote self-efficacy (e.g., promoting modelling, imagery, success experiences, and giving feedback) and better engagement in action planning (e.g., helping individuals to identify salient cues, forming if-then plans) to assist individuals with better engagement in dietary intake and physical activity behaviour and to promote better outcomes in health contexts.

Summary

The current thesis reported an evaluation of the HEALTHI program, and intervention designed to facilitate changes in dietary intake and physical activity behaviour and in turn lead to improvement in biomedical, behavioural, and psychological outcomes related to the examined health behaviours. The additional components given to the two intervention conditions (implementation intentions, mental imagery, and goal-reminder text messages) did not result in greater engagement in the health behaviours beyond that of the psycho-education weight-loss condition. Overweight and obese participants assigned to all conditions in the current study exhibited weight-loss and reduction of obesity-related risk factors over time. The research has provided some limited evidence that the components common to all conditions including self-monitoring and formulating goals may have been sufficient in affecting the change. Some key HAPA model hypotheses were confirmed when examining the predictive validity of the model's psychological components in the context of the intervention, consistent with previous research (Barg et al., 2012; Kreausukon et al., 2012). The research provided some support for the use of the HAPA variables to predict changes in physical activity and dietary intake-related outcomes within the weight-loss intervention program. The current research also found that the HAPA components were not successful mediators in explaining the intervention components responsible for change.

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Appendix A: Intellectual Input Form and Copyright Permission Statements

The nature and extent of the intellectual input by the candidate and co-authors for the two published articles has been validated by all authors.

14 March 2016

School of Psychology and Speech Pathology
Curtin University
GPO Box U1987
Perth, Western Australia, 6845

To Whom It May Concern

I, Anne Hattar, made a significant contribution to the publications entitled:

1. Hattar, A., Hagger, M. S., and Pal, S. (2015). Weight-loss intervention using implementation intentions and mental imagery: A randomised control trial study protocol. *BioMed Central Public Health, 15,196.* doi:1186/s12889-015-1578-8.
2. Hattar, A., Hagger, M. S., and Pal, S. (2016). Predicting physical activity-related outcomes in overweight and obese adults: A Health Action Process Approach. *Applied Psychology: Health and Wellbeing*. Advance online publication. doi:10.1111/aphw.12065

I created and developed the HEALTHI program which is discussed within the above publications. I coordinated and implemented all aspects of data collection for the project. I entered and processed the data, contributed to the data analyses and provided significant input into the interpretation of the findings. I assisted with the manuscript drafting and editing process.

Anne Hattar _____

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate.

Martin Hagger _____

Sebely Pal _____

Copyright Permission Statements

Permission Statement 1

Hattar, A., Hagger, S. M., & Pal, S. (2015). Weight-loss intervention using implementation intentions and mental imagery: a randomised control trial study protocol, *BMC Public Health, 15: 159.*

From: BMCSeriesEditorial [mailto:BMCSeriesEditorial@biomedcentral.com]
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Yours sincerely
Anne Hattar
Postgraduate Researcher | School of Psychology and Speech Pathology
Health Psychology & Behavioural Medicine Research Group
Curtin University

Letter attached to email

11 November 2015
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BioMed Central
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London WC1X 8HB
United Kingdom

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Hattar, A., Hagger, M. S., and Pal, S. (2016). Predicting physical activity-related outcomes in overweight and obese adults: A Health Action Process Approach. ***Applied Psychology: Health and Well-being, 8*****(1), 127-151.**
doi:10.1111/aphw.12065

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Yours sincerely

Anne Hattar

Postgraduate Researcher | School of Psychology and Speech Pathology

Health Psychology & Behavioural Medicine Research Group

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I would like to reproduce an extract of this work in a doctoral thesis which I am currently undertaking at Curtin University in Perth, Western Australia. The subject of my research is the development, implementation, and examination of the effects of a brief, low cost, theory based weight loss intervention titled the HEALTHI (Healthy Eating and Active LifesTyle Health Intervention) Program which adopts the behaviour change techniques of *mental imagery* and *implementation intentions*. The 12 week randomised-controlled intervention aimed to improve physical activity and dietary intake behaviour to facilitate weight loss in overweight and obese individuals. *I am carrying out this research in my own right and have no association with any commercial organisation or sponsor.*

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Appendix B: Focus Group Copy of the Intervention Script

Script and Draft Video Presentation

*All three conditions will hear the information in the normal font (CD 1 & CD 2).
* Only the conditions with the mental imagery and implementation intention components will hear the information in the italic font (CD 2 only).

Setting: Clinic Room
Study Information

- **[Slide 1 – "Weight-loss study program"].** Hello, my name is Anne Hattar and I am a Registered Psychologist, currently conducting some studies at Curtin University.
- During this video, I will provide you with information in the hope that this will assist you in your weight-loss 'journey.' At times you will be asked to pause the video presentation to complete questions included in the "Video Questionnaire," so please have the URL access open.
- **[Slide 2 – What you will need? (list and URL link)].** You will also need your food, drink and exercise diary, the calorie king book, your diet and exercise handout and a pen. If you need to grab any of these things, please pause the video and then play when you are ready to continue. Pause the video now [Pause].
- Great, let's get started!

Psycho-education about obesity risk and weight-loss.

- Overweight and obesity is a major health problem confronting Australia. Obesity increases the risk of a number of physiological health problems, such as diabetes, heart disease, and some cancers. Psychological factors related to obesity include increased risk of depression, low self-esteem and impaired quality of life. Weight-loss can assist in reducing obesity and its related risk issues.
- Weight-loss occurs when you either burn more calories through exercise, or eat fewer calories within your diet. Doing both of these things together, gives you optimal results. I am going to take you through some information on guidelines that may help you to lose weight. These guidelines relate to participating in exercise and changing your diet. We will first discuss exercise, and then cover diet related aspects to weight-loss.

Setting: Local Park
Exercise

- **[Slide – Title "Exercise"].**

- I'm going to begin by explaining what physical activity is versus exercise. Physical activity is any type of movement that requires us to contract our muscles, such as walking, housework, and going up and down the stairs.
- To assist with weight-loss, it is recommended that you engage in physical activity and are as active as possible all day long. For example, walking as much as possible. This could include getting off the bus when you are two bus stops away from your house, so you have a further distance to walk home. Another example would be to take the stairs instead of the lifts or escalators.
- This program recommends that you are physically active. In addition, this program recommends that you engage in a minimum of 30 minutes of planned exercise each day. You may choose a longer period of time to exercise if possible. Please take a moment to view the guidelines
- **[Slide 3 – Physical activity and exercise guidelines.** Slide content: The Guideline: Engage in physical activity and be as active as possible. Engage in a minimum of 30 minutes of planned daily exercise].
- Exercise is a specific form of physical activity that is planned and performed with the intention to increase fitness levels or gain health benefits. For example, cycling, swimming, and running. Exercise is beneficial to assist with weight-loss.
- Exercise is physical activity that increases your heart rate. Generally speaking, the more your heart rate increases, then the more intense your exercise is. In turn, this means you may be burning more calories. For this reason we suggest that you ensure your heart rate is high while you are exercising. Some examples of types of exercise you can perform to reach your 30 minute daily exercise goal includes: brisk walking, running, swimming, cycling, jogging, dance class, exercise classes or instructional exercise videos. [**Slide 4 – Exercise examples.** Slide content: brisk walking, running, swimming, cycling, jogging, dance class, exercise classes or instructional exercise videos]. You can perform exercise at home, attend a gym, or even around your neighbourhood such as your local park.
- Have a look at the "recording physical activity table" within the Food, drinks and Exercise diary. [**Slide 5 – Recording physical activity table**]. Try and take on the activities that have higher numbers allocated to them as they will be more beneficial to assist with your weight-loss. For example, the activities under code 9 will be more intense exercise activities compared to the lower numbered activities. If there is an exercise that you would like to do that is not included in this table, you are welcome to ask the researcher what code this activity may fall under.

Setting: Kitchen

Diet

- **[Slide – Title "Diet"].**
- Now it is time for us to look at your diet, what you eat and what you drink. To assist in reducing weight and maintaining a healthy body weight a change

in diet is beneficial. This program suggests that you consume a specific number of calories per day. Please take a moment to view the diet guideline **[Slide 6 – Calorie guideline].**

- The number of daily calories you need to consume to lose weight has been calculated based on your individual body needs. The number of calories you need to consume per day has been calculated for you based on your individual body needs, and is on the top of the first page of your food, drink and exercise diary
- **[Slide 7 – Exercise diary picture].** [Pause].

Props: 600ML bottles diet coca cola, coca cola, orange juice, water.

Drink Calorie Content

- **[Slide – Title: "Diet – Drink Calorie Content"].**
- When it comes to drinks, water is the best option as it has zero calories. The second best is usually diet soft drinks that contain a few calories, compared to regular soft drink or even some juices.
- For example, 600 ml diet coca cola contains 2.4 calorie, and coca cola contains 258 calories (350 ml Page 49). Water and diet drinks also contain fewer calories than orange juice, which for a 600ML amount, has approx. 255 calories.

Setting: Clinic Room
Weight-loss Guideline Reminder

- **[Slide – Title: "Weight-loss Guidelines"].**
- So far we have discussed how to lose weight. **[Slide 29 – Weight-loss guidelines].** That is, you need to be as physically active as possible and exercise for at least 30 minutes each day. Each day you will also need to consume your specified amount of recommended calories.

Recoding Information: Diet and Exercise

- I would like to briefly look at how you can record this information **[Slide Title – "Recording Information: Diet and Exercise"].**
- We need you to record your exercise to help you remember what you have done, and record your food intake to help you count up how many calories you have used each day. We want you to do this for your own records.
- For example, if I exercised for 30 minutes by riding my bike I would record the date, time, and exercise activity.
- Also, write down the foods you eat EVERY day to help you add up your calorie intake. Each day, record on a piece of paper or in an exercise book, the food and drinks you have eaten and the relevant calorie amount.
- It is helpful to prepare a meal plan with details of what you will eat each day in advance to make sure you have calculated enough calories to use and enjoy for the whole day. Then if any changes occur you can record these to the

meal plan. You can keep a record of your diet and exercise activity using any preferred method. For example it may look like this.

- **[Slide 30 – recording information].** The exercise details are up the top. And food and drink details are also shown with time, food item, description, and calorie amount.
- This record of your diet and exercise activity each day is for you to keep to help you reach your goal. Within the week of each of your clinic appointments, you will need to complete and record a 3 consecutive day record of your exercise and diet in advance and bring this it to your appointment. This is what we need – the food, drink, and exercise diary.

Intervention: General Information

- **[Slide Title: "Intervention Strategies - Diet and Exercise"].**
- *Losing weight can be challenging and so we have created simple exercises to help you. Wanting to lose weight and having the intention to diet and exercise is not enough to reach your goals. Research has shown that you are more likely to carry out your intentions to eat healthy and exercise on each occasion, if you make the decision about:* ***[Slide 54 – intervention strategies list]*** *… the times and places you will exercise and eat healthy, how you plan to carry out your goals, and imagine the steps needed to reach your goals*
- *The activities we will do include setting goals, imagining yourself doing the steps to reach your goal, and creating a plan to help you remember your goal. We will do each of these three steps for physical activity and then for diet.*

Intervention: Exercise

Physical Activity Goal Setting

- I want you to explore how you will reach the first intervention guideline… **[Slide – Physical Activity guideline]**… …to engage in physical activity and be as active as possible. And to engage in a minimum of 30 minutes of planned daily exercise
- It is important to think realistically about ways to reach this goal of exercising? What exercise would you like to do? Some examples are walking, jogging, and swimming.
- Think about and write down some specific goals of how you will reach these physical activity and exercise guideline. The goals should cover something you can do for at least the next 12 weeks.
- For example, every morning I will do 30 minutes on my exercise bike. Or I will walk around the local park every day after work for 30 minutes.
- What will you do? Write 2 to 3 goals. Record your goals using page 1 of your exercise and diet handout. **[Slide – PA Goal setting instructions].** Pause the video now. [Pause].

Physical Activity Mental Imagery

- *To help you reach your goals, I would like you to imagine yourself doing the steps needed to reach the goals you created. When imagining yourself taking the steps to reach your goal, you are asked to imagine using as many of your 5 senses as possible. This includes…* ***[Slide – list of the five senses]…****touch, taste, hearing, sight, and smell.*
- *This task is believed to assist in increasing your confidence to carry out your goals and this is why it is important for us to take the time to do this. I will take you through an example of how to do this activity, and then will ask you to do this activity (visualisation task) specific to your goals.*
- *Now I need to imagine myself taking the steps to reach my goal of exercising each morning for 30 minutes using my exercise bike.* ***[Slide – Mental imagery exercise using exercise bike].*** *For example, I imagine that I had just finished having my morning coffee at the breakfast table (taste, sight). I imagine that as I have finished, I walk to the kitchen with a cup. I then rinse my cup under the tap. I can feel the water on my skin (touch) and hear the sound of the water from the tap (hearing). I then walk to the living room and can see my exercise bike (sight). I sit on the bike, feeling the pressure of my body rest on the bike seat (touch). I press the on button using my right index finger (touch). I start to move my right foot on the pedal, then my left foot (touch). I feel my legs and feet moving in a circular motion (touch). I continue to imagine myself doing this (touch, sight). I can see that on the exercise bike screen the information is changing with my heart rate increasing (sight). I later hear the sound of my breathing increase, and I feel my sweat coming down my forehead (hearing and touch). I can smell some of my sweat as I have worked out a lot today (smell). Time passes and I notice on my screen that I have been exercising for 30 minutes (sight). Now that I am finished, I get off my bike. I feel hot and sweaty (touch) so I walk away from the living room and towards the bathroom to shower (sight). Try to keep this picture in your mind.*
- *Now as you can see I imagined all the steps in great detail and really tried to do it vividly without leaving out any details that are needed to meet my goal. Now, it is your turn to try this. You will need to imagine yourself taking the steps required to reach the exercise goals you listed earlier. It may help you to close your eyes as you imagine this task. Remember to visualise the steps required to reach your goal by using your 5 senses as much as possible: touch, taste, hearing, sight and smell. Pause the video and take the time to do this for EACH of your exercise goals. Once you have finished, press play to continue.* ***[Slide – visualisation task instructions].*** *Pause the video now. [Pause].*
- *I am going to ask you to record the steps you took to imagine your goal. For example, based on my visualisation task I would write the following* ***[Slide – recording visualisation task for physical activity section displaying the specified list].*** *1.Finished coffee (taste coffee). 2.Walking to kitchen, washing cup (sight and touch). 3.Walking to living room where bike it (sight). 4.Sitting on the exercise bike (touch). 5.Seeing the bike monitor screen (sight). 6.Pressing the on button of the bike with my finger (touch). 7.Moving legs in*

circular motion (touch, sight). 8.Feeling my sweat on forehead (smell, sight). 9.Smelling my sweat. Feeling hot. (smell, touch). 10.Getting off bike (sight). 11.Walking towards the shower (sight).

- *I know that it is a bit of detail for you to record however; I encourage you to write as much as possible about the steps you imagined for all of your goals. Although it may take some time, it will help you, and you only need to write this down once for the exercise guidelines. Please turn to page 3 of your exercise and diet handout, and write down your answers. Pause the video and press play when you are ready to continue.* ***[Slide - mental imagery visualisation task instructions****]. Pause the video now. [Pause].*

Physical Activity Implementation Intentions

- *I would now like you to create a plan targeting your participation in physical activity and planned exercise for a minimum of 30 minutes daily. Each plan, will be based on each of the goals you wrote down. This plan will also consider the things you imagined when taking the steps to reach your goal. To help you create your plans you will use an "If..then.." format that will include the when, where, and the how aspects of your plan to exercise.* ***[Slide - If/then, when, where, how].***
- *The advantage of using these types of plans is you associate something in your environment (such as a time, object, and situation) with the behaviour you want to do (such as exercising). By having these hints in your environment it will help you to remember that you need to do the plan you said you will do, such as to exercise.*
- *Please identify a time or place you can associate your goal with, such as a certain period of the day, or maybe a section of the day, such as after meals, when getting out of bed, or before work. Pay particular attention to the specific situations in which you will implement your plans.*
- ***[Slide – Physical activity examples of If/then plans]****. For example, "****If*** *I have finished my morning coffee (when),* ***then I will*** *exercise for 30 minutes at home (where) on my exercise bike (how)." Another example could be "****If*** *I am at work (where and when),* ***then I will*** *take the stairs instead of the lift up to the fifth floor (how).*
- *Now these are just examples. I ask that you think about your If/then plans remembering your when, where, and how, and create your plan to be physically active and exercise for a minimum of 30 minutes a day. Pause the video and write your answers on page 4 of your diet and exercise handout.* ***[Slide – If/then plan instructions].*** *Pause the video now. [Pause].*
- *I ask that you reflect on the plans you wrote down. Ask yourself…****[Slide – checking the If/then plan****]…do you have a plan for each of your goals? Do your plans include the if/then format? Do they include the when, where, and how details of your plans. Does your plan relate to a specific environmental cue such as an object, situation, or time, such as section of the day? If it does not, then you are asked to pause the video and resume once you have modified your plans to include this detailed information. Please write these*

changes down on your diet and exercise handout. Pause the video now. [Pause].

Intervention: Diet

Diet Goal Setting

- **[Slide - title "Diet: Goal setting"].**
- We are now done with the activities for the physical activities guideline, and we will now repeat these activities for the diet guideline. I want you to explore how you will reach the second intervention guideline:… **[Slide 42- diet guideline]…**to consume your recommended calories each day.
- Think about your need to consume the recommended daily calories. It is important to think realistically about ways to reach this diet goal.
- What food would you like to consume? What goals will assist you to reach this guideline?
- Some examples are writing a menu plan and after counting the calories, preparing foods in advance on the Sunday and Wednesday of each week, keeping the food in the fridge. Another example is cleaning the kitchen cupboards and getting rid of high calorie foods, or having diet jelly for dessert and not other high calorie desserts.
- Right now you will list 2-3 diet goals that you can do for the next twelve weeks (show screen). Your goals may want to cover two areas: Goals to keep your calorie intake to a minimum and goals to count the calories. Please pause the video and resume once you have finished recording your diet goals on page 2 of the exercise and diet handout. **[Side 43 – diet goal setting instructions].** Pause the video now. [Pause].

Diet Mental Imagery

- *Now, as we had done with the physical activity goals, I would like you to imagine the steps needed to reach your diet goals. That is, to imagine yourself taking the steps needed to carry out each of the diet goals you listed. As mentioned earlier, imagine yourself carrying out the steps needed for your goal, while using as many of your 5 senses as you can.*
- *For example, if my goal is that when I feel like dessert, I will only have diet jelly which contains fewer calories. Then, I would imagine the steps needed to reach this goal.*
- *I will take you through the steps I would imagine to reach my goal of using the prepared diet jelly for dessert.* ***[Slide 44 – Mental imagery diet example].*** *I imagine that I want dessert after dinner. I imagine that I walk to the kitchen and approach the fridge (sight) and I open the fridge with my right hand (touch). I then imagine selecting the diet jelly container I had prepared earlier (touch and sight). I open the cupboard and grab a plate and spoon (sight, touch). I pour 5 spoons worth of jelly into my plate (sight, touch), each time watching myself pour the spoons into my plate. I see my plate having more and more jelly with each spoon added (sight). I return the container to the fridge (sight, touch) again opening the fridge with my right hand and*

returning the container on the shelf. I then walk towards the kitchen bench and grab my jelly plate and spoon with my hands (sight, touch). I walk back to the dining table holding my plate (touch). I place my plate on the table and sit down (sight). I then grab my spoon and have a mouthful of jelly (touch). I can taste and smell the mango flavoured jelly (sight, taste, smell). I continue to eat my jelly slowly (taste). Try to keep this picture in your mind.

- *As you can see I imagined all the steps in detail that I need to meet my goal. Now, it is your turn to imagine the steps needed for each of your diet goals. Try and close your eyes to help you imagine this task. Remember to visualise the steps required by using your 5 senses as much as possible. That is,…**[Slide 34 – five senses]…**touch, taste, hearing, sight and smell. Pause the video to take the time to do this now and once you are done press play to continue. **[Slide 45 – instructions mental imagery diet].** Please pause the video now. [Pause].*
- *I am going to ask you to please record the steps you took to mentally imagine each of your diet goals. For example, I imagined the following... **[Slide 46 – recording visualisation task mental imagery]…**1.Walking to kitchen, seeing fridge, opening door (sight, touch). 2.Select diet jelly container (touch and sight). 3.Open the cupboard and grab a plate and spoon (sight, touch). 4.Pouring five spoons worth of jelly into my plate (sight, touch). 5.Plate has increasing amounts of jelly with each pour (sight). 6.Return jelly container to the fridge and open fridge door (sight, touch). 7.Grab my jelly plate and spoon with my hands (sight, touch). 8.Walk to dining table holding my plate (touch). 9.Put plate on table and sit down (sight). 10.Grab my spoon and have a bite of the jelly (touch). 11.Taste and smell the mango flavoured jelly (sight, taste, smell). 12. Eat jelly slowly (sight, taste, smell).*
- *Please take the time to write as much as possible about the steps you imagined for all of your diet goals. Again, I know this will take some time, but this is the **last** time you need to do this, and it will help **you** to reach your goal. Please turn to page 5 of your exercise and diet handout. Please pause the video and press play when you are ready to continue. **[Slide - mental imagery visualisation task instructions**]. Pause the video now. [Pause].*

Diet Implementation Intentions

- *Now, I will take you through the planning activity we did for exercise and physical activity. This time we will make an If/then plan to target the goal of calorie consumption.*
- *Think about your diet goals and the steps you imagined to reach them. Try and find a plan where you can associate something in your environment (such as a time, object, and situation) with the behaviour you want to do (such as calorie counting). Identify a time or place you can associate your goal with, such as a certain period of the day, or maybe a section of the day such as after meals, when getting out of bed, or before work. Pay particular attention to the specific situations in which you will implement your plans. Again, to help you do this, I want you to create your goal using an "If/then" format that includes the when, where, and how aspects of your goal.*

- *For example…**[Slide 47 - If/then plan examples]**….my If/then plan "**If** I want dessert after dinner (when) when at home (where), **then I will** have the diet jelly I prepared in the fridge." Or an If/then plan that relates to a goal of counting calories includes "**If** I am to eat any food or drink (when), **then I will** read the label or use my book to calorie count (how) no matter where I am (where)." Or **If** I want to eat out (when), **then I will** look at the restaurant's menu online, prior to arriving and I will choose my meal and count the calories before I arrive (how) to check if I can have this option on arrival (where).*
- *These are just a few examples. What plans can **you** create that relate to each of your goals. Think about your If/then plans remembering your when, where, and how part of your plan to consume your specified daily calorie intake. Make a plan for each of your goals. Pause the video and write your answers on page 6 of your diet and exercise handout. **[Slide 48 – If/then plan instructions].** Please pause the video now. [Pause].*
- *I ask that you reflect on the plans you wrote down. Ask yourself… **[Slide 49- If/then plans checklist]**…do you have a plan for each of your goals? Do your plans include the if/then format? Do they include the when, where, and how details of your plans. Does it relate to a specific environmental cue such as an object, situation, or time (such as section of the day)? If it does not, then you are asked to pause the video and resume once you have modified your plans to include this detailed information. Please write these changes down on your diet and exercise handout. Please pause the video now. [Pause].*
- *Now you have finished creating your goals, plans and have also imaged the steps required.*

Complete Video Questionnaire

- I ask that you complete and submit the Video Questionnaire available from the URL link. **[Slide 50 – video questionnaire instructions].** Press pause the video to answer the questions and then press play when you are ready to continue. After you complete this, I have just a **few** final words. You can pause the video now. [Pause].

Intervention Conclusions

- Thank you for watching this presentation and being a part of this intervention. Please make sure you have submitted your video questionnaire if you have used the URL link by clicking on the submit button. You will also need to provide the researcher with the diet and exercise handout you just completed. A copy will be sent to you via mail or email. At the top of the diet and exercise handout, please tick your preferred option and provide either your email or address details. **[Slide 51 – handout showing mail versus email address option].**
- I hope that the information has been helpful and I wish you all the best with following the intervention weight-loss guidelines. Please remember to complete the food, drinks, and exercise diary prior to attending each of your

clinic appointments. You may want to put a reminder in your phone or diary to ensure you don't forget when you are due to complete the 3 day record. It is important that you attend the clinic appointments in time so we can monitor your progress.

- Thank you once again and good luck **[Side 52 – Thank you slide].**

Appendix C: Focus Group Participant's Demographic Information

1. Name: _____
2. Gender: Male ☐ Female ☐
3. Date of Birth: _____ / _____ / _____
4. Height: _____
5. Weight: _____
6. Where were you born? Country (please specify): _____
   Mother's country of birth: _____
   Father's country of birth: _____
7. What is your ethnic origin? Caucasian ☐
   Asian ☐
   Other (specify): _____

8. What is your highest level of schooling? *(Tick one box)*
   - Never attended school ☐
   - Primary school ☐
   - Some high school ☐
   - Completed high school ☐
   - Technical/Trade certificate ☐
   - University or Tertiary level ☐
9. If appropriate, list the title of your highest qualification (degree or certificate)?

   _____

10. What is your current employment status? *(Tick one box)*
    - Don`t work ☐
    - Full time employment ☐
    - Part time employment ☐
    - Home duties (e.g.: gardening) ☐
    - Other (please specify) ☐

      _____

Appendix D: Focus Group Participant Invitation and Consent Form

Focus Group Invitation Information Sheet

My name is Anne Hattar, a Doctor of Philosophy (Clinical Psychology) student from Curtin University. I invite you to participate in a **Focus Group Session** for my PhD thesis on weight loss. This study is being supervised by Professor Martin Hagger (School of Psychology) and Associate Professor Sebely Pal (School of Public Health).

Purpose

I invite you to attend a Focus Group Session that will require you to watch a 40 minute weight loss video presentation intervention program. The purpose of the focus group session will be to provide me with any feedback to improve the delivery of the information that is presented in the weight loss intervention.

What participation involves

- Watching a video presentation about weight loss information;
- Completing activities during and following the intervention;
- Providing any feedback to assist in improving the interventions effectiveness;

Focus group details

Date:	[Information omitted]
Time:	[Information omitted]
Location:	[Information omitted]
	Curtin University of Technology (Bentley)

Further information

If you would like to accept this invitation please email me on weightloss@curtin.edu.au by 11th October 2013. If you would like to arrange for a Parking Permit, have any questions, or would like more information please contact me via email on weightloss@curtin.edu.au

Thank you

Kind Regards
Anne Hattar

CONSENT FORM

- I have read the Focus Group invitation information sheet and have been given the opportunity to have any questions answered.
- I acknowledge that I understand the purpose of the focus group.
- I agree to participate in the focus group, however understand that my participation is voluntary, and that I can have a change of mind and withdraw from the focus group at any time without any negative consequences.
- I understand that the focus group results may be published; however no personal or confidential information will be used to identify me.
- I consent to the focus group discussion being recorded via audio tape.
- I accept that the written and verbal information I provide during the focus group may be documented and stored. I understand that access to my information will be available to the researcher, research supervisors, and research assistants. I understand that the information provided will only be used for the purpose of this study.
- I accept that copies of the written and verbal information provided during the focus group may be stored in a locked cabinet in the School of Psychology for fifty years, and then destroyed.
- I am aware that the study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HR137/2013).

Signed: _____ Date: _____
(Participant)

Signed: _____ Date: _____
(Researcher, Anne Hattar)

Appendix E: Program Information Handout

Date: _____ Time: _____

Participant ID number: _____

I would like to receive a copy of this handout via (select option):

- ☐ **Post. Postal address: _____**
- ☐ **Email. Email address: _____**

DIET AND EXERCISE ACTIVITIES

The following questions are ONLY to be completed when you have been prompted to do so during the video presentation. Please listen to the prompts that advise you when you can turn the page.

Thank you

PHYSICAL ACTIVITY

Guideline: To participate in a minimum of 30 minutes of exercise daily.

GOALS LIST

Please list your PHYSICAL ACTIVITY goals below:

1. _____

_____

_____

_____

_____

_____

_____

_____

2. _____

_____

_____

_____

_____

_____

_____

_____

3. _____

_____

_____

_____

_____

_____

_____

_____

DIET

Guideline: To consume the specified number of calories per day.

GOALS LIST

Please list your DIET goals below:

1. _____

2. _____

3. _____

PHYSICAL ACTIVITY
Guideline: To participate in a minimum of 30 minutes of exercise daily.

MENTAL IMAGERY STEPS

Please list the steps that you imagined doing for each of your PHYSICAL ACTIVITY goals.

1. _____
_____
_____
_____
_____
_____
_____
_____

2. _____
_____
_____
_____
_____
_____
_____
_____

3. _____
_____
_____
_____
_____
_____
_____
_____

PHYSICAL ACTIVITY

Guideline: To participate in a minimum of 30 minutes of exercise daily.

IF/THEN PLANS

Please write your PHYSICAL ACTIVITY plans on the lines below, following the format shown in the video presentation example ("if… then…").

1. If_____
_____
_____
Then I will_____
_____
_____
_____

2. If_____
_____
_____
Then I will_____
_____
_____
_____

3. If_____
_____
_____
Then I will_____
_____
_____
_____

DIET

Guideline: To consume the specified number of calories per day.

MENTAL IMAGERY STEPS

Please list the steps that you imagined doing for each of your DIET goals.

1. _____
_____
_____
_____
_____
_____
_____
_____

2. _____
_____
_____
_____
_____
_____
_____
_____

3. _____
_____
_____
_____
_____
_____
_____
_____

DIET

Guideline: To consume the specified number of calories per day.

IF/THEN PLANS

Please write your DIET plans on the lines below, following the format shown in the video presentation example ("if… then…").

1. If_____
   _____
   _____

   Then I will_____
   _____
   _____
   _____

2. If_____
   _____
   _____

   Then I will_____
   _____
   _____
   _____

4. If_____
   _____
   _____

   Then I will_____
   _____
   _____
   _____

Appendix F: Focus Group Script and Research Questions

Focus Group Script

Focus Group opening

My name is Anne Hattar, a Doctor of Philosophy (Clinical Psychology) student from Curtin University. I have invited you to participate in a Focus Group Session for my PhD thesis on weight-loss and obesity.

Verbal consent to record the focus group

I will be conducting a focus group and this will be your opportunity to express your thoughts and share your opinions about a video intervention. I will be recording this session, to ensure I don't miss any of the valuable information you provide. You can ask to stop the recording at any time. The recording will ONLY be heard by me (and potentially a research assistant), however a transcript may be produced and potentially published within my PhD thesis. Your name will not be written next to what you have said. The recording will be deleted after I have transcribed the provided information. The results from this focus group and another group (with community sample/health professionals) will be used to create a report and the feedback will be used to make amendments for a final version of the video intervention. Are there any questions before I turn on the recorder?

Purpose statement and introduction

The Focus Group Session involves you watching a 40 minute video presentation which is an intervention program. The video presentation provides weight-loss information and will be used to assist overweight and obese individuals in the community to lose weight. Participants will be completing this activity on their own; however for the purpose of this focus group we will be watching this video in a group setting.

While watching the video you will be asked to complete activities during and following the intervention. The purpose of the focus group session will be to provide me with feedback to improve the delivery of the information that is presented in the weight-loss intervention. I hope that this feedback will assist me in improving the interventions effectiveness.

I will provide you with a script of the video intervention. Please feel free to write on the script and use the left hand column to write comments. I will be collecting this at the conclusion of the focus group. For example, if you believe a section needs clarification you could put a question mark and then circle the text within the script. In addition, if you believe a section is not necessary then you could write in the left hand column "remove" and then cross out the text within the script. You may ask me to stop the video if you feel like you might need a few seconds to record your comments on the script.

The study will have three conditions, and all participants will hear the information in the black normal font (recorded on CD 1 & CD 2). Two of the study conditions will also receive the information in the black italics font which is based on psychological theory.

Before we get started, I would like to inform you that this is a draft version of the video. I would like to inform you that the exercise section was meant to be filmed at a park, however weather conditions did not permit filming in that location. For this section, I have stood in front of a park image and for the final edition I will be filming the exercise section at a park. Also, the video editing is not to a professional standard and for the final video a video editor will be used. This will ensure the video is to a professional standard, and the slides that appear will be correctly timed, with slides showing only when discussing the slide content, and slide disappearing when returning back to the main topic. A teleprompter will also be used when filming the final version thus eye contact will be directed at the camera at all times. Does anyone have any questions before we get started?

[View weight-loss intervention video].

Questions

I am going to begin by asking some questions which may lead to a discussion of some areas of improvement. The questions have no right or wrong answers. I would just like to know your opinion and thoughts. All suggestions are welcome as constructive feedback is appreciated as the aim is to improve the overall quality and effectiveness of the intervention.

Focus Group Research Questions

Study information and psycho-education

1. What are your thoughts about the introduction section capturing the purpose of the study? (Are the aims clear?).
2. Are there any other comments about the Study information and psycho-education section?

Exercise section

3. What is your opinion in regards to the physical activity section?
    a. Is the physical activity information easy or difficult to understand?
    b. Are the physical activity guidelines clear or do they require improvement?
4. Are there any other comments about the exercise section?

Diet section

5. What is your opinion in regards to the diet section?
    a. Is the diet information easy or difficult to understand?
        i. Did the section provide enough or too much information on how to calorie count?
        ii. Are there any thoughts on the information provided about how to calorie count for drinks?

iii. Was the information on how to use nutritional labels sufficient or limited?
iv. Was the information on how to use the calorie counting book sufficient or limited?

b. Are the diet guidelines clear or do they require improvement?

6. Are there any other comments about the diet section?

Recording Information

7. Based on what you watched, what are your thoughts in relation to the information provided on how to record the diet and exercise information? (That is, that a food diary should be kept for one's own records, and the three day food and exercise log book is to be handed in. Is it clear or unclear?).

Intervention – Exercise and Diet

8. I would like to get your feedback on the intervention itself, which is the part when participants are asked to set goals, mentally imagine their goals, and then set an If/then plan. These three steps were completed for the diet section, and then the physical activity section.
    a. What are your thoughts about the goal setting sections? (activity instructions, information)
    b. What are your thoughts about the mental imagery sections? (activity instructions, information)
    c. What are your thoughts about the If/then plans sections? (activity instructions, information)

Other

9. What are your options about the slides?
    a. (Too much or too little information; format, font).
10. What are your thoughts on the content?
    a. (Too much or too little information on a specific section?)
11. What are your thoughts about the length of the intervention?
    a. (e.g., which sections or information can be shortened)
12. What are your thoughts about the film setting, such as the kitchen, park, and grey wall?
13. What is your opinion about the facilitator (myself) presence in the video?
    a. (For example, the distance from the camera, voice clarity, lighting, dress standards).
14. Is there anything else you would like to contribute to this focus group?

Appendix G: Final Version of the Modified Intervention Script

HEALTHI Program - Video Presentation Intervention Script

*All three conditions will hear the information in the normal font (displayed within version 1 and 2). Only the conditions with the mental imagery and implementation intention components will hear the information in the italic font (displayed within version 2 only).

Setting: Clinic Room

Video 1:

Study Information

- **[Slide 1.1 – "HEALTHI program"].**
- Hello and welcome to the HEALTHI program. My name is Anne Hattar and I am a Registered Psychologist. During this video presentation, I will provide you with information in the hope that it will assist you in your health and weight-loss 'journey.' Throughout the program you will be asked to watch some videos and complete various activities. In addition, you will need to watch the videos carefully; as throughout the program you will be asked questions based on some key concepts discussed within the video presentation.
- We all have different reasons to why we want to lose weight. So why do you want to lose weight? Is it to improve your health? Or is it to feel more comfortable with your body? Do you want to improve your physical appearance? Or become a good role model for your children? I want you to think about your reasons for weight-loss at this stage. This section of the video presentation will now come to an end so that you can list these weight-loss reasons. When the video ends, I ask that you select the 'next' button on the bottom right hand corner of your screen and follow the instructions.

Video 2:

- Whatever the reason for you wanting to lose weight, I want to help you to get there! If you have tried to lose weight in the past, you would know that sometimes it isn't easy and we do not always feel motivated to do the things that will help us lose weight. This is totally normal, and this is why the HEALTHI program tries to keep weight-loss simple, by introducing you to two guidelines that you will be asked to meet one day at a time.

Psycho-education about obesity risk and weight-loss.

- As mentioned, losing weight is important to you, and it can also assist in reducing obesity-related risk factors. This includes health problems, such as diabetes, heart disease, and some cancers, as well as psychological problems,

such as decreasing the risk of depression, low self-esteem and impaired quality of life.

- As you probably know, weight-loss occurs when you either burn more calories through exercise, or eat fewer calories within your diet. Doing both of these things together, gives you optimal results. As part of the HEALTHI program I am going to take you through some information that may help you to lose weight. I will discuss with you two guidelines that relate to participating in physical activity and changing your dietary energy intake.
- One day at a time, you will need to try to meet these two guidelines in the area of physical activity and dietary energy intake. Each day you will reset these guidelines and try your best to achieve them. The reason we look at these guidelines one day at a time, is it makes it easier for us to commit to taking the actions to reach our goals. It also means that if we have a bad day, we can get back on track as soon as possible. We will first discuss physical activity, and then cover the dietary energy intake information related to weight-loss.

Setting: Local Park

Video 2 (continued):

Physical Activity

- **[Slide 2.1 – Title "Physical Activity"].**
- I'm going to begin by explaining what physical activity is versus exercise. Physical activity is any type of movement that requires us to contract our muscles, such as walking, housework, and going up and down the stairs.
- To assist with weight-loss, it is recommended that you engage in physical activity and are as active as possible all day long. Each day you are asked to make small choices to remain physically active. For example, walking as much as possible. This could include getting off the bus when you are two bus stops away from your house, so you have a further distance to walk home. Another example would be to take the stairs instead of the lifts or escalators. These small choices you make each day can contribute a larger effect towards your weight-loss goals.
- The HEALTHI program's physical activity guideline has two components. First, we recommend that you are physically active. Also, it is recommended that you engage in a minimum of 30 minutes of planned daily exercise. If you feel like doing more exercise, then you may. Each day you are asked to try your best to do as much as possible. Please take a moment to view the physical activity guidelines. **[Slide 2.2 – Physical activity and exercise guidelines].**
- Exercise is a specific form of physical activity that is planned and performed with the intention to increase fitness levels or gain health benefits. For example, cycling, swimming, and running. Exercise is beneficial to assist with weight-loss.
- Exercise is physical activity that increases your heart rate. Generally speaking, the more your heart rate increases, then the more intense your

exercise is. In turn, this means you may be burning more calories. We suggest that you start and end your exercise session with a few minutes of light intensity exercise to warm your body up and cool down, however for the majority of your exercise session to engage in moderate to vigorous exercise intensity. So how do you determine your exercise intensity?

- *Light intensity* activities feels easy to do. Some indicators that you are exercising at a light intensity level include: **[Slide 2.3 – Light exercise intensity]**
    - No noticeable changes in your breathing pattern;
    - No sweat resulting from the exercise (excludes sweat from hot or humid weather); and/or
    - Able to carry on a full conversation or sing.
- *Moderate intensity* activity feels somewhat hard. Some indicators that you are exercising at a moderate intensity level include: **[Slide 2.4 – Moderate exercise intensity]**
    - Breathing pattern quickens, however you are not out of breath;
    - A light sweat results from exercise, after approximately 10 minutes of exercising; and/or
    - Able to carry on a conversation, however you are unable to sing.
- *Vigorous intensity* activity feels challenging. Some indicators that you are exercising at a vigorous intensity level include: **[Slide 2.5 – Vigorous exercise intensity]**
    - Breathing pattern becomes rapid and deep;
    - A sweat results from exercise, after a few minutes of exercising; and/or
    - Not able to carry on a conversation. You may only be able to say a few words before pausing for breath.
- Some examples of the types of exercise you can perform to reach your 30 minute daily exercise goal include: **[Slide 2.6 – Exercise examples]**
    - …..brisk walking, running, swimming, cycling, jogging, dance classes, exercise classes or instructional exercise videos.
- You can perform exercises at home, attend a gym, or even around your neighbourhood such as your local park.
- The next slide will show you a picture of the "recording physical activity table" which you have within your Food, Drink and Exercise diary. **[Slide 2.7 – Recording physical activity table].** Try and take on the activities that have higher numbers allocated to them as these activities are higher in intensity and so they may be more beneficial to assist with your weight-loss. For example, the activities under code 9 will be more intense exercise activities compared to the lower numbered activities.
- If there is an exercise that you would like to do that is not included in this table, you are welcome to ask the researcher what code this activity may fall under. You can make contact in person or via email.
- As the guideline states, try to remain physically active, and plan a minimum of 30 minutes of exercise each day. If you miss a day, then just aim to reach the guideline the next day and start again. Each day is a new beginning. You are not expected to make up for the days that you missed. Having said that, if

you ever want to exercise more than 30 minutes on any given day, then you may.

- Although it is better if you try to do the 30 minutes of exercise in the one setting, if you are unable to then there are a few options to help you to get there.
- If it has been a while since you have exercised, then you can slowly build up your fitness levels. For example, John started by going for a ten minute walk around his block each day. By the fourth day, he found this easier, so he walked at a faster pace and for 15 minutes this time. Two weeks later he was able to walk briskly for 30 minutes continuously.
- Sarah also tried to slowly build up her physical activity levels. She committed to the 30 minutes of continuous exercise time and what she did is walk at a fast pace, then when she felt she could not walk that fast any longer, she would walk at a slower pace until she caught her breath, then she would walk very fast again. After 2 weeks, Sarah was able to walk at a fast pace for the whole 30 minutes without needing to slow down.
- Another option could be to divide the 30 minutes of exercise throughout the day. For example, Jane was motivated to lose weight and so she broke down her 30 minute exercise goal throughout her day. She exercised three times a day in 10 minute blocks each time. The first block was walking with her son from the house to her son's school and then she would walk back home alone. Her second block was walking from her house, on her own, to her son's school. She would then pick up her son from school and walk home with him. She really enjoyed these walks as it gave her time alone to chat with her son. Jane's third exercise block was using her Wii to play a fun dancing game. A few weeks later, Jane found that she could walk for longer periods of time. She now does her 30 minute exercise in one setting through exercise instructional videos on her Wii. She also adds in that little extra to be physically active by continuing to walk to and from her son's school each weekday morning and afternoon.
- It is up to you how you would like to exercise and try to meet the daily goal of exercising for 30 minutes. If you need to build up your fitness levels before you can get to this goal then you may. And if you have any medical conditions, experience any concerns or difficulties when exercising, or just want some expert advice in relation to what exercise intensity is right for you, then it is best that you speak to your doctor or a professional exercise specialist. They will be able to support you given your individual requirements.
- If you are exercising at a vigorous exercise intensity level then it would be normal to feel your breathing is deep and rapid, and that you can only say a few words at a time before needing to pause for breath. However, overexerting yourself is not good. Some signs to look out for that may indicate you are pushing yourself too hard, include being short of breath or experiencing pain. If this occurs then slow down, build your intensity level gradually, and if necessary seek some advice from a health professional.
- Now it is time for us to look at your dietary energy intake, what you eat and what you drink.

Setting: Kitchen

Video 2 (continued):

Dietary energy intake

- **[Slide 2.8 – Title "Dietary Intake"].**
- To assist in reducing weight and improving your health, a change in dietary energy intake is beneficial. The HEALTHI program suggests that you monitor your dietary energy intake and consume a specific number of calories or kilojoules per day. Please take a moment to view the dietary energy intake guideline. **[Slide 2.9 – Dietary intake guideline].**
- As part of the HEALTHI program, you will need to monitor your energy consumption intake which is measured using calories or kilojoules. Both calories and kilojoules are units of measurement for the energy content within food or drink items. For example, a calorie is a unit of heat energy, and the body needs to use this heat energy to function. Foods and drinks contain a different amount of calories or kilojoules. I will be referring mainly to calories instead of kilojoules as the preferred term for measuring energy content.
- As part of the HEALTHI program, the number of daily calories you need to consume to lose weight has been calculated for you, based on your individual body needs. There is a minimum amount of calories and you cannot have less than this amount, one reason is your body will need to have enough energy for you to function. The maximum calorie amount is the most calories that you can have on any given day to help you lose weight. The maximum amount is provided to ensure that you do not provide your body with too many calories, which would impact on your ability to lose weight.
- So we ask that your energy intake amount is somewhere in-between your minimum and maximum calorie or kilojoule amount. This section of the video will now end. I ask that you follow the screen's prompts and click on the 'next' button to view your minimum and maximum calorie or kilojoule allowance amount.

Video 3:

- So now that we know what your current energy intake requirements are for weight-loss. As you begin to lose weight, your body needs may change and so at future clinic appointments you may be given a different daily calorie or kilojoule allowance. However, for the next 6 weeks please ensure your energy intake from your diet is somewhere in-between the minimum and maximum calorie or kilojoule allowance amount you were just given. As mentioned I will be referring mainly to calories instead of kilojoules as the preferred term for measuring energy content.
- Before I discuss how to count calories, I would like to inform you that not all low calorie foods or drinks are better for your health. It is important to have a balance between meeting your calorie allowance amount and eating healthy.

Weight-loss can be achieved through calorie counting, however not all low calorie drinks and foods are healthier. For example, orange juice is deemed to be better for your health, although it will contain more calories compared to the unhealthier low calorie drinks such as diet coke. To help you get this balance, I will first discuss how to calorie count, as this is the weight-loss method, and then I will talk about the Australian Dietary guidelines which will provide some suggestions on how to maintain a healthy diet.

- To achieve weight-loss, we need to provide our body with fewer calories than it needs so that the body uses the energy stored within the body as fat. So in order to do this, we exercise to burn calories, but to obtain the best results, we also need to reduce the amount of calories we consume each day.
- So how do we monitor our dietary energy intake and count calories? When buying products from the supermarkets, you will find nutritional labels displayed. Usually they are found on the back or sometimes side of the food or drink item. It looks something like this.
- **[Slide 3.1 – Nutritional information labels].** These nutritional labels can vary slightly for each food or drink product. The labels contain product-specific information including serving size, energy content such as in calories or kilojoules, and nutritional information.
- When reading the labels, the first thing to look at is the serving size and the number of servings in the package. The serving sizes allow us to make simple comparisons between similar types of foods; they are provided in units that are familiar; including a number of grams (for example, 100 grams), cups, or pieces.
- **[Slide 3.2 Marination sauce 1].** So for example, if one type of marination sauce has 41 calories per 100mL, and another type has 51 calories per 100mL, I can see which of the two types of sauces has fewer calories.
- Once you have read the serving size for the specific product, including how many servings in the food package, you should ask yourself how many servings am I having? (for example, 2 servings, 1 serving, or maybe halve a serving).
- For example, **[Slide 3.3A Marination sauce 2]**…if the marination sauce product states that the servings per package is 4, and the… **[Slide 3.3B Marination sauce 2]**……serving size is a quarter of a cup, then I can calculate how much I am having. I am going to eat half a cup worth and so I am having 2 servings. The next step is to look at the energy content information. [Slide 3.3C Marination sauce 2]. Usually towards the top of the table, the energy content information, which is provided in the measurement of calories displayed as C-a-l, or kilojoules displayed as K-J per serving, and per a familiar unit of measurement such as a cup or 100ml. You can estimate the energy content of food by either using the measurement of kilojoules or calories, however stick to the same type of unit measurement to prevent confusion. **[Slide 3.3D Marination sauce 2].** This information gives you an indicator of how much energy you will get from a serving of the food or drink product. Then the next thing to do is to calculate the energy content using the measurement of kilojoules or calories. Here, I look at how many calories I consumed. The number of servings you have influences the amount of

calories you have (as it is calculated based on the portion amount you had). For example, according to the nutritional information label, each serving of a quarter of a cup is 25 calories. I consumed half a cup of marination sauce, which is equivalent to 2 servings. So I multiply 25 calories by 2 servings. That is a total of 50 calories.

- Let's look at another example. **[Demonstration:** Display 98% fat free Premium snack pack on bench]. **[Slide 3.4A – Premium snack pack label].** Looking at the nutritional label for Premium Snack Packs (98% Fat free), the red arrow shows that for this food product, a serving size is 4 biscuits. As shown by the blue arrow each serving, which we now know is 4 biscuits contains 409 kilojoules. So I only want one biscuit, which means I am having a quarter of the serving size. I then calculate the energy content, or how many calories my portion of the serving size contains. **[Slide 3.4B – Premium snack pack label].** I know that the serving size is 4 biscuits, and that the 4 biscuits have 409 kilojoules. So if I only want 1 biscuit then I will divide the kilojoule amount for one serving size by 4. **[Slide 3.4C – Premium snack pack label].** If I want to use calories as my energy content measurement unit and not kilojoules then I can convert the kilojoule information to calories, using the conversion formula. An example of how to use this formula has been recorded for you in your HEALTHI program handout. This next screen shows you the calculation.
- **[Slide 3.5 – Converting between Calories and Kilojoules].**
    - Converting Calories to Kilojoules
        - 1 Cal = 4.2 KJs
        - Food/drink (in cal amount) x 4.2 = KJ content in the food/drink
    - Converting Kilojoules to Calories
        - 1 KJ = 0.24 Cal
        - Food/drink (in KJ amount) x 0.24 = calorie content in the food/drink
- When reading the nutritional labels you will notice that the number of nutrients is also displayed, **[Slide 3.6 – Nutrients displayed]**…this could include total fat, cholesterol, sodium, dietary fibre, and/or iron. Although this is useful information it is not relevant to the task of measuring energy content. You may dismiss this information.
- As we have discussed, once you locate the nutritional label, the next step is to determine the number of servings per package, how many servings will you will be having, and the energy content information or corresponding calorie or kilojoules amount. After you have done this, you can record the calorie or kilojoule content information to help you keep a track of your energy intake consumption.
- Once you have worked out the calorie amount, you may want to use a marker and write on the box, how many calories the item has, to help you out next time you have this product.
- If you are eating out, you may be given the energy intake information in calories or kilojoules or need to calculate it yourself. Some places such as Nandos, Boost Juice, and Subway, will have a list of their foods or drinks and

the calories that relate to the item. Sometimes, it is displayed on the wall menu of the shop, and at other times you may need to ask and the information can be easily provided.

- For example, Boost Juice displays the energy content information in kilojoules under the drink menu information on the wall. [**Demonstration**: Show Boost Juice pamphlet]. They also usually have copies of a little pamphlet with the list of drinks and energy content information which they can give you if you ask.
- Many places also have a website that provides a list of the foods' nutritional information including energy content in calories and kilojoules. Most people are unaware of this, but if the nutritional information is not evidently displayed, sometimes the staff can still provide you with the information if you ask. So it's nice and easy to keep track of your energy consumption and count calories at these places.
- Thinking about calorie counting can sometimes feel like it will be a bit of work. Calorie counting is actually quite simple once you have learnt how, and it will require less effort as time goes on. Also, the good news is you won't always have to calorie count. For example, you probably have a favourite breakfast, and once you have worked out the calorie amount the first time, then the next time you have that breakfast, you don't have to calculate it. Also, eating out can *still* be easy. So for example, if you go to the same restaurants, and order the same meals, then once you have calculated the calorie content the first time, then each time you order that meal, you already know how many calories you are having and you will not need to re-calculate it!
- Another good thing about calorie counting is that if you plan your food in advance, then you can still eat whatever you want! Like if you want to have chocolate, then have it. Maybe you can have a lighter lunch to make up for the calories in the chocolate. Or maybe just have a smaller piece of chocolate then you usually do!
- Calorie counting can be easily applied to your life once you start to understand how to do it. If you are a busy person like myself, then you will also appreciate how you will get faster and faster at doing it. Also, being such a busy person, I also have some lean cuisine frozen meals I keep in the freezer which have the calorie amount displayed on the nutritional label so all the work has been done for me!
- Also if you cook for a family, just because you want to calorie count, it doesn't mean you have to make any changes when preparing the family's meals. For example, Sally cooks for her husband and child. She keeps a notebook handy in the kitchen, and with each added ingredient she looks at the nutritional label and writes down the corresponding energy content information in calories. She does this for each product and then calculates the total calorie amount within the family meal. She ends up eating only a quarter of the food amount she has cooked. So, Sally then divides the total calorie amount in the family meal by 4, so that she is aware of how many calories *she* consumed. To help keep her calorie intake within her requirements, she may also cook the family an extra dish that she will not eat such as baked

potatoes or pasta. Instead she will have an extra portion of green salads. She needs to add the green salad calorie amount to her total and then she is done!

- So when we calorie count, the first choice is to use nutritional labels or any available information that specifically displays the calorie amount such as wall menus. If neither of these things are available then you will need to calculate the number of calories you consume per day by using the **[Slide 3.7 – Calorie King book]**….Calorie King book we provided you with.
- For example, at fine dining restaurants, you may need to calculate how many calories your food or drink has by estimating the portion of food and using your Calorie King book. At times this may mean you need to examine the menu description or ask the waiter what food items are in the foods sauces or dressing to allow you to count the calories. Or, you can go without the dressing and not count it!
- I know there are other methods that you could use to count calories; however for the purpose of the HEALTHI program, in order of preference, **[Slide 3.8 – Order of preference]**… **only** use nutritional labels or specific item descriptions, and then the Calorie King book provided to you.
- This will ensure better accuracy for you, which means better weight-loss results!
- Please have your Calorie King book in front of you so we can go through how to use it. Even if you are aware of its use, I encourage you to sit through and listen to how **we** at the HEALTHI program would like you to use this book.
- Now, let's say for breakfast, I used a little bit of oil spray to cook a fried egg, and also had a slice of wholemeal bread. **[Demonstration:** Kitchen – cooking spray oil, egg, wholemeal bread]. I will need to count how many calories I had. It is good habit to write down the foods that you eat to help you keep track of the calories within your diet intake. I would like to count the number of calories within this breakfast. My first preference would be to use the food items' nutritional labels. However, if this is not available, then I would use my calorie counting book.
- So let's look at the nutritional labels. For the wholemeal bread, the nutritional label is on the back of the bread packet. **[Slide 3.10 - Bread nutritional label].** As per the red circle, the serving size is equivalent to 2 slices of bread. As per the green circle, per serving there is 618 kilojoules or after calculations 148 calories. I only had half a serving, being 1 slice of bread. Thus I would only record half the amount of calories or kilojoules per the serving amount. That is 74 calories.
- Now let's take a look at the oil. **[Slide 3.11 - Coles Canola Oil Cooking Spray nutritional label].** As per the red circle, 1 serving of Coles Canola Oil Cooking Spray is 2 grams. As per the green circle, 1 serving has 74 kilojoules or 18 calories. I had two servings being a light spray on the pan, and so I need to multiple the one serving size calorie amount by 2. This is 18 calories multiplied by 2 servings which is 36 calories.
- To look up the calorie content for the eggs, again, I will use the nutritional label on the carton. [Slide 3.12 - Egg cartons nutritional label]. According to

the label, as per the red circle, a serving is made up of 2 eggs. As per the green circle, there are 581 kilojoules or 139 calories per serving.

- I only had one egg, which is half the serving amount. This also means the energy content will be half of that displayed for the serving amount. This is 69.5 calories for the one egg. To make things easier I will round up to 70 calories.
- If the nutritional label was not available, such as if I threw out the egg carton, then I would need to use my Calorie King book.
- So, I have given you examples on how to calculate the energy intake content for the items within my breakfast. Now I would add up the total calorie amount within the breakfast.
- **[Slide 3.13A – Breakfast calories (bread, oil, egg total)].** So, according to the nutritional labels, the breakfast contained a total of 180 calories. To make sure I am following the dietary energy intake guideline, I would subtract the breakfast calorie amount from my daily total maximum calorie intake allowance.
- **[Slide 3.13B – Breakfast calories (bread, oil, egg total)].** So if you are allowed a maximum of 1,500 calories per day, you would subtract 180 calories from 1,500 calories. This would mean you now have between your minimum calorie amount and 1,320 calories remaining. These remaining calories would be used for lunch, dinner, and possibly some snacks.
- Now the breakfast calculation was based on the preferred method which is using nutritional labels. But just for demonstration purposes, I will show you how to calculate the energy content for the same breakfast using the Calorie King book. To do this, I will refer to the contents page headings or index page to guide me to where I will find the food items I am looking for.
- **[Slide 3.14 - Contents page].** For example, using the contents page, I can see the words "bread & bread products, bagels," which directs me to page 56, and the title "eggs, egg substitutes, egg dishes" which directs me to page 93.
- You may also use the index page to search for an item. **[Slide 3.15 – Index page].** For example on page 235 of the index page you find the page number for "Eggs" listed.
- So now that we know eggs are on page 93. Turning to this page we find Fried egg listed. **[Slide 3.16 – Egg nutritional label from calorie king book].** It shows that for two plain fried eggs there are 265 calories. As I only had one egg, I have only consumed half this amount which is 132.5. To make things easier, I will round up to 133 calories.
- Now when I used the nutritional labels to calculate the calorie amount within one egg, it was 70 calories and the spray oil was 36 calories **[Slide 3.17 – Fried Egg].** This means that according to the nutritional labels the fried egg contained 106 calories, but the Calorie King book states that a fried egg has 133 calories. That is such a difference! And sometimes you will notice that there will be differences in the energy content calorie amount between the nutritional label and the Calorie King book. The reason this happens is because the nutritional label is specific to the food or drink item, which is why we ask that nutritional labels are used as your first preference. Whereas the Calorie King book is sometimes an estimate of the calorie amount for a

certain food type and in some cases is based on assumptions of the ingredients within the food item. In this specific case, an assumption was probably made about the egg size and the amount and type of oil used to fry the egg, and this would impact on the respective calorie content amount. Whereas, using the nutritional labels I know exactly how many calories is within the specific egg and the low fat oil I have used.

- Shortly, this section of the video presentation is going to end so that you can practice using the Calorie King book to calculate energy content. Please click the 'next' button and follow the prompts on your screen.

Video 4

- To find the answer you may have used **[Slide 4.1 – Content and Index pages]**…the contents page which showed **fats, butter, spreads oils** are on page 94. OR maybe you used the index page which also showed olive oil is on page 94. **[Slide 4.2 – Olive oil spray calorie content].** Then turning to page 94 of the book, the olive oil spray (5g serving) is shown to have 30 calories. If you are still unsure of how we got to this answer please talk to the researcher today.
- So it may help to plan your breakfast, lunch, dinner, and snacks in advance to make sure you spread your calorie allowance throughout your day. To ensure your calorie amount is sufficient throughout your whole day, it may mean you eat less of the high calorie foods you may have eaten in the past. Healthy foods usually contain fewer calories compared to junk food.
- For example, **[Slide 4.3 –Comparing Calories Pictures]** a 50g packet of Smiths Original Potato chips has 255 calories and would take up so many of your daily calories, so instead, for your snack you can have a medium sized cucumber or apples which has only 10 or 75 calories respectively.
- So instead of eating that small packet of chips you could have 25 cucumbers! Or 3 and a half apples for the same calorie amount. So the healthy snack might keep you feeling full for longer.
- **[Slide 4.4 – Comparing Calories].** Another example, is when making a sandwich you could substitute 2 slices of white toast bread, with most brands having 160 to 200 calories, sometimes more with 2 corn cakes instead, such as Simply Less thin corn cakes, which have about 56 calories. This simple swap, means you may have consumed 3 to 4 times less calories.
- **[Demonstration:** Show Tuna cans]. Another example is, John West 95g tuna can.
- **[Slide 4.5– Tuna Can Nutritional Label].** As shown on the left hand side, the tuna in spring water is 289 kilojoules which is 69 calories, whereas flavoured tuna cans vary in calorie content and can even have double the amount, such as the lemon and cracked pepper flavour shown on the right hand side of the screen which has 550 kilojoules which is 132 calories.
- So I can have 1 can of lemon and cracked pepper tuna, or 2 cans of non-flavoured tuna for the same amount of calories.
- To help you reduce your energy intake or ensure you have enough calories to enjoy your food and not exceed your calorie allowance, it is important that

you choose meals and drinks that have fewer calories. It might also help if you know a bit about how to follow the Australian Dietary Guidelines. This information is also important to assist you in ensuring you have a balance between calorie counting and maintaining a healthy diet.

- **[Slide 4.6 – Australian dietary guidelines].** You will be provided with a copy of these guidelines. The guidelines recommend that each day you drink plenty of water. Research suggests that you aim for at least 2 litres per day which is about 8 glasses. The dietary guidelines also state that it is important to eat foods from the 5 categories below. Over the next few days, please have a read over these categories from your copy of the Australian Dietary Guidelines.
- The guidelines also recommend that you limit foods containing saturated fat, added salt, added sugar, and alcohol.
- So based on this information, some good meal ideas are listed. **[Slide 4.7 – Meal Ideas Breakfast].** Here are some breakfast ideas. **[Slide 4.8 – Meal Ideas Lunch or Dinner].** Here are some lunch or dinner ideas. **[Slide 4.9 – Meal Ideas Snacks and Desserts].** Here are some snack and dessert ideas.
- It may help if you eat breakfast and ensure this is a meal that keeps you feeling satisfied. For me, breakfast is my largest meal. It helps me to feel full for longer, so I reduce the amount of snacks that I have throughout my day. Also, having a lighter dinner may be helpful, as the food that you eat just before you sleep cannot be expended. Try this and see how you go! The best thing about the HEALTHI program's dietary energy intake guideline is that you have the flexibility to do what you want to assist you in meeting the program's requirements. So you can make changes and see if it will work for you. As discussed, it may be helpful for you to choose meals and drinks that have fewer calories.
- **[Slide 4.10– Choosing Foods/Drinks with fewer calories].** For example, by lowering your sugar and fat intake you can reduce your energy content calorie amount. This can be done by using reduced fat or light margarine spreads and oils. You can also avoid fried food and instead cook food using minimal fats and oils. This includes microwaving, grilling, and steaming. Also, you can choose lean meat cuts with minimal marbling, and chicken breast. Trimming off any visible fat and skin is also important.
- **[Slide 4.11 – Calorie comparison].** For example, when comparing 100g of beef steak grilled fillet that has some untrimmed fat, it contains 205 calories, and compared to a beef steak lean cut (with all visible fat removed) containing 195 calories (page 131). Also, 100 grams of chicken breast meat with skin has 165 calories compared to a chicken breast lean cut, without skin, containing 105 calories (p. 75).
- When I made these comparisons, I talked about the foods in terms of 100 grams. To use the Calorie King book you may sometimes need to know how many grams the food item has. If you are cooking, then you can weigh the foods using a scale while the food is raw or estimate the food quantity through the packaging. For example, if I bought a packet of 300 grams of chicken breast, and I had approximately half the chicken within the packet, then I know that I have had half of 300 grams which is 150 grams. If the food

has been cooked, say for example you are eating out then you can still estimate the food's weight by using the visual tool provided to you.

- **[Slide 4.12 – Visual Tool].** This visual tool can be found within your orientation handout. For example, the palm of your hand is equivalent to approximately 100 grams.
- You will find that by choosing a low sugar or reduced fat alternative for various foods and drinks; will assist you in keeping your energy intake through calorie consumption to a minimum, while you still enjoy the same food or drink. [**Demonstration:** Props: 2 take-away coffee cups with the label showing the calorie amount]. For example, drinking a skim milk cappuccino has 70 calories, while a full fat cappuccino with whole milk is almost double the amount of calories, containing 125 calories. So in this way you can still have a cappuccino, but by choosing the lower fat version it means you are consuming half the amount of calories.

Setting: Kitchen

Video 4 (continued):
Dietary energy intake section continued; Drink calorie content

- Now, I would like to discuss the energy content information contained within drinks.
- **[Slide 4.13 –Dietary Energy Intake: Drink Calorie Content].**
- **[Demonstration:** 600ML bottles diet coca cola, coca cola, orange juice, water. Include labels on table]. When it comes to drinks, water is the best option as it has zero calories. If we are looking at drinks from a calorie perspective, then the second best option is usually diet soft drinks that contain fewer calories, as compared to regular soft drinks or even some juices. For example, a 600 ml diet coca cola contains 2.4 calories, and coca cola contains 258 calories (350 ml Page 49). Water and diet drinks also contain fewer calories than orange juice, which for a 600ML amount, has approximately 256 calories.
- As mentioned earlier, it is important to have a balance between calorie counting and healthy eating and drinking, as not all low calorie items are best for our health. So when looking at the drink options you may opt for an orange juice even though it has more calories. To make things fun, you can even use a blender to make your own healthy refreshing juices using pure fruit, ice, and skim milk or juice.
- **[Demonstration**: Props: Banana, berries, Ice, Juice or Skim Milk, cup. Make in blender]. So we have now talked about how to calorie count and I know it might sound like it requires some effort. At the start it will, but as time goes on it does get easier and easier and you will not *always* need to calorie count. For example, I have three breakfast options and I know how many calories each of them has. So I never calorie count my breakfasts anymore. Remember it is the small choices you make each day that can lead to a big difference. And if you go over your calorie allowance on a certain day, that is okay. Try your best to continue the day making healthy choices and not give

up because you have already exceeded the calorie amount. It is important that you try to make healthy choices and at the same time not deprive yourself of food.

- For example, by lunch time, Sam had exceeded his maximum calorie allowance and started thinking, I have already gone off track, so I might as well eat whatever I want for dinner and just reset the guidelines tomorrow. Then he remembered why he enrolled in the HEALTHI program in the first place. He wanted to be a good role model for his children and be more involved in their active lives. So he had a change of thought, and decided that he has gone over his calorie requirements and he can't change that, but what he can do is make sure he improves his planning for the rest of the day. For dinner, he had a green salad and he increased his exercise amount that day.
- It is important that we learn from our mistakes, and when you reset the HEALTHI program guidelines for the following day just try to be more careful!

Setting: Clinic Room

Video 4 (continued):
Reminder of guidelines

- **[Slide 4.14 – Weight-loss Guidelines Summary].**
- So far we have discussed how to lose weight.
- **[Slide 4.15 – Guidelines summary].** That is, you need to be as physically active as possible and engage in a minimum of 30 minutes of planned daily exercise. Each day you will also need to ensure your energy intake from diet is somewhere in between your minimum and maximum calorie or kilojoule allowance amount.
- These HEALTHI program guidelines are to be set at the start of each day. So it is taking the guidelines one day at a time. If for any reason you do not meet them on a certain day, then just try again the following day. Feeling discouraged or guilty cannot reverse the bad days you have. Instead learning from your mistakes and moving forward is the best way to achieve your weight-loss goal. Each day is a new beginning. And the guidelines are there to assist you to lose weight. Try and focus on following these guidelines, and avoid constantly weighing yourself. Sometimes even when the numbers on the scale are not moving it does not mean that you have not contributed positively to your goals. I know it can feel frustrating when no weight change has occurred, but remember if you are following the guidelines then there can be another explanation. It could be that you have increased your muscle mass or water mass. Also even with no weight change has occurred you may be contributing to a healthier you by following the guidelines! You could be reducing the obesity-related risk factors. For example, you may be helping to decrease your blood pressure and cholesterol level which is leading to better health. Continue to follow these guidelines for the next 12 weeks. The only thing you have to lose is weight. Remember, even the small choices you

make each day can help contribute to a larger result and take you a step closer to your goal.

- Next, I would like to briefly look at the need to record information.

Video 4 (continued):
Recording information: Dietary energy intake and exercise.

- Within the week of each of your clinic appointments, you will need to complete the relevant online survey and complete the 3 consecutive day food, drinks and exercise diary in advance and bring this in to your clinic appointment.
- **[Slide 4.16 – Recording Information: Dietary energy intake and exercise].** This is, what we at the HEALTHI program need from you:
    - Complete the relevant online survey, and
    - Complete the 3 day food, drink, and exercise diary.
- Although, we do not need any more information from you, we strongly recommend that you record your exercise to help you remember what you have done, and record your food and drink intake to help you count up how many calories you have had each day. We want you to do this for your own records. We will not collect this information from you, it is just advised you do this to help you get to your goal! To do this you may want to record it using the same format as the 3 day food, drink and exercise dairy, or you may have another format that you prefer to use.
- **[Slide 4.17 – Recording information].** For example, take a look at how Sally completed her personal record. She exercised for 30 minutes by riding her push bike and thus recorded the date, time, and exercise activity. She recorded her exercise details up the top. And food and drink details are also shown with time, food item, description, and calorie amount. She wrote down the foods she ate EVERY day to help her add up her calorie intake.
- The HEALTHI program strongly suggests that each day, you also record on a calorie counting journal, a piece of paper, or exercise book, or even your mobile phone the food and drinks you have eaten and the relevant calorie amount.
- It is helpful to prepare a meal plan with details of what you will eat each day in advance to make sure you have calculated enough calories to use and enjoy for the whole day. Then if any changes occur you can record these to the meal plan. You can keep a record of your dietary energy intake and exercise activity using any preferred method. This record of your dietary energy intake and exercise activity each day is for you to keep to help you to reach your goals.
- Losing weight can be challenging and so we have created simple exercises to help you. I know you have good reasons to want to lose weight. This section of the video is going to end briefly in order for you to read your weight-loss reasons that you listed previously as this may help motivate you towards your goals. When the video ends, please follow the screen prompts and click on the ‘next’ button to continue.

Video 5 (intervention conditions only).
Intervention: General Information.

- *We all know that sometimes we really want to do something such as to lose weight and we make goals but we don't succeed. That is totally normal, because research has shown that although we may have good intentions we don't always follow through with the behaviour that will help us get there. A good example of that are New Year's resolutions. We have the best intention to start the New Year with a goal such as to eat healthy then a few days later we go back to doing what we have always done in the past. Again, this is totally normal. Unfortunately, having good intentions to diet and exercise is not enough for us to reach our goals. Research has shown that you are more likely to carry out your intentions to eat healthier and exercise on each occasion, if you make the decisions about:*
- ***[Slide 5.1 – Intervention Strategies: Dietary energy intake and exercise]****…the times and places you will exercise and eat healthy, how you plan to carry out your goals, imagine the steps needed to reach your goals, and imagine what it would feel like if you reached your goal.*
- *The activities we will do include setting goals, imagining yourself doing the steps to reach your goal, creating a plan to help you remember your goals, and imaging what it would feel like to reach your goal. We will do each of these steps for physical activity and then for dietary energy intake. Research has shown that by doing these activities it will help you to complete the behaviours related to reaching your goals. For example, it may assist you in remembering your plans and good intentions, and increase your motivation and confidence in your ability to change your behaviour.*
- *In order to get started, when this section of the video ends, please click on the 'next' button to continue.*

Video 6
Physical Activity Goal Setting

- **[Slide 6.1 – Creating Physical Activity Goals].**
- I want you to explore how you will reach the first program physical activity guideline **[Slide 6.2 – Physical activity guideline**]…to engage in physical activity and be as active as possible, and to engage in a minimum of 30 minutes of planned daily exercise.
- To be as physically active as possible means making small decisions to be active throughout your day. Such as taking the stairs instead of the lifts. Also, it is necessary to plan when you will exercise each day. It is not always easy to do at least 30 minutes of daily exercise, but the small choices you make each day can lead to a big difference helping you to lose weight. We discussed previously that you can slowly build yourself up to this target. Such as doing 3 blocks of 10 minute exercise periods until you can complete a 30 minute exercise block continuously. Or walking at a slow pace for 30 minutes and increasing the intensity throughout the walk.

- It is important to think realistically about ways to reach this goal of exercising? What exercise would you like to do? Some examples are walking, jogging, and swimming.
- We are going to think about and later write down some specific goals of how you will reach this physical activity guideline. The goals should cover something you can do for at least the next 12 weeks.
- To help you create your goals, we will create SMART goals. I will discuss SMART goals using both physical activity and dietary energy intake examples, as we will be using SMART goals again when we go through the dietary energy intake guidelines.
- **[Slide 6.3 – SMART Goals].** SMART stands for: Specific, Measurable, Attainable, Realistic and Time Targeted.
- To create a SMART goal we need to ensure our goal has all of the components. This is important and so we will go through each of these components.
- **[Slide 6.4 – SMART Goals Specific].** S - Specific: The goal needs to be specific in that you know what you want to accomplish. To say, "I want to lose weight" is too broad and it would be difficult to evaluate. So you need to be more specific. For example your goal could be to exercise using your exercise bike for 30 minutes, or diet by calorie counting with a minimum and maximum calorie amount.
- **[Slide 6.5 – SMART Goals Measurable].** M - Measurable: the goal needs to be something you can measure so that you know when you have accomplished it. So you need to clearly define your goals so you know when you reached them. For example, if it is exercising at a vigorous exercise intensity level then you could say “I will exercise so that I will not be able to carry out a conversation for a 30 minute duration.” For calorie counting you could measure how you will accomplish your goal if you say “I will consume calories within my minimum and maximum calorie allowance amount,” and record your diet intake so you can check your progress.
- **[Slide 6.6- SMART Goals Attainable].** A - Attainable: the goal needs to be something that is attainable. Ensure the goal is something you can reach. For example, if you decide you want to consume only 300 calories per day or want to exercise by sprinting for 3 hours a day, then you may have set an unattainable goal. A SMART weight reduction goal would be to consume the recommended daily calorie amount, and gradually build up your exercise levels using a combination of power walking and then jogging.
- **[Slide 6.7 – SMART Goals Realistic].** R - Realistic: the goals needs to be realistic. So is it likely you can do it? If you have such a busy schedule and you have set a goal of going to the gym on a daily basis so you can exercise for one hour, or to cook each day after work then it may not be realistic for you. This would mean you might want to re-think your goal. A realistic goal would be going to the gym three times a week for one hour, and on the other days of the week setting the goal of going for a 30 minute walk around the local park. In regards to making your cooking goal realistic, you may set the goal of cooking every second or third day.

- **[Slide 6.8 – SMART Goals Time Targeted].** T - Time Targeted: the goal needs to have a time frame. For example, how long will the goal take and set a timetable. For example, exercising 30 minutes per day and eating a calorie restricted diet may be a goal for the program period of 12 weeks. Following this time frame you may want to re-set your goals.
- Now, to create a SMART goal it needs to include all of the 5 components we just discussed. So, let's read through some examples of planned exercise goals. **[Slide 6.9 – SMART Goals for planned exercise].** Starting from tomorrow (date), I am going to try to use my exercise bike each weekday at 5PM or after work, for at least 30 minutes, to complete moderately intense cardio five days of the week. I will commit to this goal for the next 12 weeks. **[Slide 6.10 – SMART Goals for planned exercise].** Starting from the upcoming weekend (date), I am going to walk around the local park with my dog at 8AM, for at least 30 minutes, to complete moderately intense cardio, the Saturday and Sunday of each week. I will commit to this goal for the next 12 weeks.
- Some examples of SMART goals to be physically active include. **[Slide 6.11 – SMART Goals to be physically active].** Starting from tomorrow (date), I am going to ensure that I am physically active by taking the stairs instead of the lifts when I am at work. I will commit to this goal for the next 12 weeks. **[Slide 6.12 – SMART Goals to be physically active].** Starting from today (date), at least twice a week, when I go to Westfield Carousel I am going to park my car near the Target parking entrance, and walk to the other side of the shopping centre to get to Coles to help me be more physically active. I will commit to this goal for the next 12 weeks.
- What will you do? The video will now end so that you can record your 3 physical activity goals.

Video 7 (intervention conditions only).
Physical Activity Mental Imagery

- ***[Slide 7.1 – Imagine steps to reach your goals].***
- *To help you reach your goals, I would like you to imagine yourself doing the steps needed to reach the goals you created. By doing this activity it will help you to feel more confident in being able to carry out the steps needed. When imagining yourself taking the steps to reach your goal, you are asked to imagine them using as many of your 5 senses as possible.* ***[Slide – 7.2 Senses]****…this includes touch, taste, hearing, sight, and smell.*
- *This task is believed to assist you in increasing your confidence to carry out your goals and this is why it is important for us to take the time to do this. I will take you through an example of how to do this activity, and then will ask you to do this activity specific to each of your goals.*
- *Now, for Amy to reach the SMART goal of* ***[Slide 7.3 –Amy SMART Goal].*** *Starting from tomorrow, I am going to try to use my exercise bike each weekday at 5PM or after work, for at least 30 minutes, to complete moderately intense cardio five days of the week. I will commit to this goal for the next 12 weeks.*

- *She will need to imagine herself taking the steps to reach this exercise goal.*
- ***[Slide 7.4 – Mental imagery exercise using exercise bike]. [Camera: Video of someone on exercise bike. In the background "Amy" is reading].*** *For example, I imagine that I have just finished work. I enter the house and put my keys on the key hanger (sight). I then walk into my bedroom and grab my exercise clothes, shoes, and socks. I imagine myself changing from my work clothes into my exercise clothes (sight). I then grab my iPod and while I am walking away from my bedroom I start to look at my playlist and press play, placing my headphone plugs in my ears (sight, sound, touch). I then walk to the living room and can see my exercise bike (sight). I sit on the bike, feeling the pressure of my body rest on the bike seat (touch). I press the start button using my right index finger (touch). I start to move my right foot on the pedal, then my left foot (touch). I feel my legs and feet moving in a circular motion (touch). I continue to imagine myself doing this (touch, sight). I can see that on the exercise bike screen the information is changing with my heart rate increasing (sight). I later hear the sound of my breathing increase, and I feel and smell my sweat coming down my forehead (hearing, touch, smell). This makes me feel good, as I know I have done well and am contributing to my goal. Time passes and I notice on my screen that I have been exercising for 30 minutes (sight). Now that I am finished, I get off my bike. I see myself smiling as I feel good as I have made a positive contribution towards burning more energy to help me lose weight (sight).*
- *Try to keep this picture in your mind.*
- *Now as you can see Amy imagined all the steps in great detail and really tried to do it vividly without leaving out any details that are needed to meet her goal. Shortly it will be your turn to try this activity. You will need to imagine yourself taking the steps required to reach the physical activity and exercise goals you listed earlier. It may help you to close your eyes as you imagine this task. Remember to visualise the steps required to reach your goal by using your 5 senses as much as possible. Shortly, this section of the video is going to end to give you the time to complete this activity for EACH of your physical activity and exercise goals. You are asked to try your best to imagine the steps needed to reach your goals. I know that for some people it may be hard so it may help if you think of a time when you did exercise and how that felt and how it related to your 5 senses. Then apply those images to the goals that you just created. After you have imagined the steps for each of your goals you will be asked to record the steps you imagined. This activity is personal and everyone will differ in the specific images and senses that are used. The most important thing is that you use your senses, try to create a vivid image, and stay focused on your goal.*
- *For example, based on Amy's imagination task she would write the following.* ***[Slide 7.5 – recording imagination task for physical activity section].***
    - *1. Finished work, put keys down (sight)*
    - *2. Walking into my bedroom, getting changed (sight and touch)*
    - *3. Grabbing iPod, headphones, and pressing play to listen to music (sight, touch, sound)*
    - *4. Walking to living room where the bike is located (sight)*

    - *5. Sitting on the exercise bike (touch)*
    - *6. Seeing the bike monitor screen (sight)*
    - *7. Pressing the start button of the bike with my finger (touch)*
    - *8. Moving legs in circular motion (touch, sight)*
    - *9. Feeling and smelling my sweat on my forehead (smell, touch)*
    - *10. Getting off bike (sight, touch)*
- *I know that it is a bit of detail for you to record however; I encourage you to write as much as possible about the steps you imagined for all of your goals to help you to remember them. Although it may take some time, it will help you, and you only need to write this down once for the goals relating to the physical activity and exercise guidelines. This section of the video is now going to end. Please click on the 'next' button to continue with the HEALTHI program and complete the discussed activities.*

Video 8 (intervention conditions only).
Physical Activity Implementation Intentions

- ***[Slide 8.1 – Creating plans].***
- *I would now like you to create a plan targeting your participation in physical activity and planned exercise for a minimum of 30 minutes per day. You are asked to create three plans. Each plan will relate to each of the goals you wrote down. This plan will also consider the things you imagined when taking the steps to reach your goal.*
- ***[Slide 8.2 - If/then, when, where, how].*** *To help you create your plans, you will use an "If..then.." format that will include the when, where, and the how aspects of your plan to exercise.*
- *The advantage of using these types of plans is that you associate something in your environment (such as a time, object, and situation) with the behaviour you want to do (such as exercising). By having these hints in your environment, it will help you to remember that you need to do the plan you said you will do, such as to exercise. It can be hard to reach our goals if we don't remember to carry them out. People often have very good intentions but fail to follow them up, often because they don't have a plan of when and where they will do what they say they will do. This is why creating these plans using certain cues can be a helpful reminder that we need to do what we said we will do!*
- *Please identify a time or place with which you can associate your goal, such as a certain period of the day, or maybe a section of the day, such as after meals, when getting out of bed, or before work. Pay particular attention to the specific situations in which you will implement your plans.*
- ***[Slide 8.3 – Planning task - If/then plans example 1].*** *For example, "**If** I have arrived home after work (when), **then I will** exercise for 30 minutes at home (where) on my exercise bike (how)."* ***[Slide 8.4 – Planning task - If/then plans example 2].*** *Another example could be "**If** I am at work (where and when), **then I will** take the stairs instead of the lift up to the fifth floor (how).*

- *Now these are just examples. And I ask that you think about your If/then plans remembering your when, where, and how. This part of the video is coming to an end. When the video ends, please click on the 'next' button and follow the instructions to create your plans to be physically active and exercise for a minimum of 30 minutes a day.*

Video 9
Dietary Intake Goal Setting

- **[Slide 9.1 – Creating Dietary Energy Intake Goals].**
- We are now done with the activities for the physical activities guideline, and we will now repeat these activities for the dietary energy intake guideline. I want you to explore how you will reach this second program guideline for dietary energy intake: **[Slide 9.2- Dietary Energy Intake Guideline**]…ensure your energy intake from diet is somewhere in-between your minimum and maximum calorie or kilojoule allowance amount
- To reach this goal, it means that your dietary energy intake is somewhere in between your minimum and maximum calorie or kilojoule allowance amount. It is important to think realistically about ways to reach this dietary energy intake goal. What foods and drinks would you like to consume? What goals will assist you to reach this guideline?
- We are going to think about and later write down some specific goals on how you will reach this guideline. The goals should cover something you can do for at least the next 12 weeks. Remember it is the small choices you make each day that can lead to a big difference helping you to lose weight.
- To help you create your goals, we will create SMART goals. We have already discussed what SMART goals are using both physical activity and dietary energy intake examples. **[Slide 9.3 SMART goals]**. That is, SMART goals are: Specific, Measurable, Attainable, Realistic and Time Targeted.
- To create a SMART goal it needs to include all of these 5 components. I am going to give you some specific examples of SMART goals for the Dietary energy intake guideline, and then if you would like to replay the part of the video explaining what SMART goals are then you will be given the opportunity to do that!
- So, let's read through some examples of dietary energy intake related SMART goals.
- Some examples of SMART goals to keep your calorie amount to a minimum and to count calories include **[Slide 9.4 – SMART Goals for Calorie consumption].** Each Wednesday and Sunday afternoon, I am going to prepare my meals for the next 3 to 4 days in advance, keeping the food in the fridge with appropriate labels of the meal and weekday the food is for. I will write a menu plan and calculate the energy content amount to ensure it is between 800 to 1,500 calories which is my minimum and maximum calorie allowance amount. I will commit to this goal for the next 12 weeks. **[Slide 9.5 – SMART Goals for Calorie Consumption].** Starting from tomorrow (date), I am going to check the calorie content within food items and make

comparisons to ensure I select the product with fewer calories (for example, the low fat option). I will commit to this goal for the next 12 weeks.

- SMART goals for calorie consumption also include **[Slide 9.6 – SMART Goals for Calorie Consumption].** When purchasing food products, I will check the nutritional label for the serving size and calorie content. I will calculate the calorie amount and record this to assist me in keeping track of my daily calorie amount. I will commit to this goal for the next 12 weeks. **[Slide 9.7 – SMART Goals for Calorie Consumption].** When eating out, I will first check the online menu prior to arriving at the restaurant. I will select a healthy dish and use the information available to me to count the number of calories within the meal (using the menu description showing the calorie amount or Calorie King book). On arrival to the restaurant I will select the meal I chose in advance. I will commit to this goal for the next 12 weeks.
- What will you do? This section of the video will soon come to an end so that you can list 3 dietary energy intake goals that you can do for the next 12 weeks. As per the SMART goals that I shared, it is helpful to ensure your goals cover two areas: Goals to keep your calorie intake to a minimum and goals to count the calories. When this sections of the video ends, please click on the 'next' button and follow the screens prompts. You will be given a choice of whether you want to re-view the SMART goals explanation again before you list your dietary energy intake goals.

Video 10 (intervention conditions only).
Dietary Energy Intake Mental Imagery

- ***[Slide 10.1 (and 7.1) Imagine steps to reach your goals].***
- *Now, as we had done with the physical activity goals, I would like you to imagine the steps needed to reach your dietary energy intake goals. That is, to imagine yourself taking the steps needed to carry out each of the dietary energy intake goals you listed. Again, by doing this activity it will help you to feel more confident in being able to carry out the steps needed. When imagining yourself carrying out the steps needed for your goal, you will need to use as many of your 5 senses as possible.* ***[Slide 10.2 (and 7.2) – 5 senses]****…this includes touch, taste, hearing, sight, and smell.*
- *It is important that we do this activity as it is believed to assist in increasing your confidence in being able to carry out your goals. I will cover an example, before you get started on this activity! Now, for Safa to reach the SMART goal of:* ***[Slide 10.3 – Safa SMART goal****] …When eating out, I will first check the online menu prior to arriving at the restaurant. I will select a healthy dish and use the information available to me to count the number of calories within the meal (using the menu description showing the calorie amount or Calorie King book). On arrival to the restaurant I will select the meal I chose in advance. I will commit to this goal for the next 12 weeks.*
- *She would imagine the following. [****Camera:*** *"Safa" is reading while the camera shows someone doing the task]. I imagine that I am going to go out with some friends for dinner. I imagine that I take my phone out of my pocket (sight). I hold my phone with the palm of my left hand (sight). With my right*

hand index finger I touch my phone's screen (touch). I select the internet icon (touch, sight). I then type the name of the restaurant into the browser (sight). I open the restaurant page and click on their online menu. I look through the menu to find an appropriate dish I can have for dinner. I then get my Calorie King book and roughly estimate the number of calories in the dish. I am satisfied as I have worked out the number of calories my meal will have. Now when I go out with my friends I do not need to worry about calorie counting and know exactly what to order!

- *Try to keep this picture in your mind.*
- *As you can see Safa imagined all the steps in detail that she needs to meet her goal. She did this in great detail and tried to do it vividly without leaving out any steps needed to meet her goal.*
- *Soon it will be your turn to imagine the steps needed to reach each of your dietary energy intake goals that you listed earlier. It is suggested that you try and close your eyes to help you imagine this task and visualise the steps required by using your 5 senses as much as possible.*
- *Shortly, this section of the video is going to end to give you the time to complete this activity for EACH of your dietary energy intake goals. You are asked to try your best to imagine the steps needed to reach your goals. I know that for some people it may be hard so it may help if you think of a time when you did diet or calorie count and how it felt and how it related to your 5 senses. Then apply those images to your dietary energy intake goals that you just created. After you have imagined the steps for each of your goals you will be asked to record the steps you imagined. As mentioned earlier, this activity is personal and everyone will differ in the specific images and senses that are used. The most important thing is that you use your senses, try to create a vivid image, and stay focused on your goal.*
- *For example, based on Safa's imagination task, she would write the following* ***[Slide 10.4 – Recording Imagination Task for dietary energy intake section].***
    - *1. Take phone out of my pocket (sight).*
    - *2. Hold phone with the palm of my left hand (sight).*
    - *3. With my right hand index finger I touch my phone's screen (touch).*
    - *4. Select the internet icon (touch, sight).*
    - *5. Type the name of the restaurant into the browser (sight).*
    - *6. Open the restaurant page and click on their online menu.*
    - *7. Look through the menu to find an appropriate dish I can have for dinner (sight)*
    - *8. Grab and use Calorie King book to roughly estimate calorie content (sight)*
    - *9. At restaurant, ordering meal chosen in advance (sight, hearing).*
- *I know it is a bit of detail for you to record but I really encourage you to write as much as possible about the imagined steps to help you remember them. Again, I know this will take some time; however it will help you to reach your goal. This section of the video is going to end. When the video ends, please click on the 'next' button to continue with the HEALTHI program and complete the discussed activities.*

Video 11 (intervention conditions only).
Dietary Energy Intake Implementation Intentions

- ***[Slide 11.1 (or 8.1) – Creating plans].***
- *Now, I will take you through the planning activity we did for physical activity and the exercise guideline. This time we will make three If/then plans to target the dietary energy intake guideline and the goal of calorie consumption.*
- *Each plan, will correspond to each of the goals you listed. The plan will also consider the steps you imagined to reach these goals.*
- *Again, we will create the plans using the* ***[Slide 11.2 (same as 8.2) - If/Then Plan]****…If/then format that will also include the when, where and how aspects of your plan to monitor your dietary energy intake.*
- *It is important that you try and find plans where you can associate something in your environment (such as a time, object, and situation) with the behaviour you want to do (such as calorie counting). Identify a time or place with which you can associate your goal, such as a certain period of the day, or maybe a section of the day such as after meals, when getting out of bed, or before work. Pay particular attention to the specific situations in which you will implement your plan.*
- *It can be hard to reach our goals if we don't remember them, so by creating these plans and using certain cues it can be a helpful remind of what we said we will do!*
- *For example, my If/then plan that relates to a goal of calorie counting includes* ***[Slide 11.3 - If/then plan examples]****…"****If*** *I am to eat any food or drink (when),* ***then I will*** *read either the nutritional label, available calorie product specific information, or use my Calorie King book to calorie count (how) no matter where I am (where)." Or,* ***[Slide 11.4 - If/then plan examples]****…****If*** *I want to eat out (when),* ***then I will*** *look at the restaurant's menu online, prior to arriving and I will choose my meal and count the calories before I arrive (how) to check if I can have this option on arrival (where).*
- *These are just a few examples. What If/then plans can* ***you*** *create that relate to each of your goals. Think about your If/then plans remembering your when, where, and how part of the plan to consume your specified daily calorie intake. This section of the video is coming to an end. When the video ends, please click on the 'next' button and follow the instructions to create your dietary energy intake If/then plan specific to each of your goals.*

Video 12 (intervention conditions only).
Outcome Mental Imagery

- ***[Slide 12.1 – Imagine you reached your goals].***
- *Now, we have just one brief imagination task left that relates to your reasons for wanting to lose weight. You will be asked to imagine yourself having*

achieved your weight-loss related goals using as many of your 5 senses as possible.

- *I want you to imagine the outcome you are expecting to gain such as weight-loss or better health. You need to imagine how much effort and willpower it has taken to achieve your goal by engaging in planned exercise, keeping physically active, and keeping within your energy intake allowance for a 12 week period. Imagine that you have successfully managed to do this and you have reached your personal goal whether it was to lose weight, feel better about your appearance, improve your health, and/or increase your ability to be more physically active with your family. Imagine how satisfied you will feel. It is very important that you see yourself actually reaching your goal and keep that picture in your mind.*
- *This section of the video will end soon, and when it does I ask you click on the 'next' button and follow the prompts to view your reasons for weight-loss which may help you do this next activity, which is to imagine you have reached your goals.*

Video 13
Complete Video Questionnaire

- **[Slide 13.1 – HEALTHI Summary].**
- Thank you for completing the activities as part of the HEALTHI program.
- I hope that the information has been helpful and I wish you all the best with following the HEALTHI program guidelines. Please remember that for the week 6 and 12 clinic appointments you will need to complete the relevant online survey, and the Food, Drink, and Exercise diary before you attend each of these appointments. To help you remember to do this, you may want to put a reminder in your phone or diary the week before your next appointment. It is important that you attend the clinic appointments in time so we can monitor your progress.
- The video presentation will now come to an end. When the video finishes, please click on the 'next' button to continue with the HEALTHI program's final instructions including the completion of a questionnaire.
- Thank you for watching this presentation and being a part of this program. Good luck with your weight-loss journey **[Side 13.2 – Thank you slide].**

Note:

- The Qualtrics^{TM} program will provide the participants with the option of how they would like to receive a copy of their goals (email or post), and if in the intervention condition then in addition their if/then plans and mental imagery steps.

Appendix H: Complete List of Study Inclusion and Exclusion Criteria

Inclusion criteria. Participants must be between the age of 18 to 65 years old, and overweight or obese (Body Mass Index between: 25 to 40). The individual must not have been involved in any other weight-loss studies in the last 6 months, and will need the ability to restrict dietary intake, and increase physical activity levels. A reliable mobile phone with text messaging ability features is needed. The participant is required to attend the Clinic in Perth, Western Australia and attend all data collection time periods. Participants will be expected to complete the questionnaires and a record of physical activity and food intake for a three day periods when required. Participants will need to consent to blood samples, and the DEXA body composition scan.

Exclusion criteria. Females who are pregnant, trying to become pregnant, or lactating will be excluded from the study. Participants who are diagnosed or believe they may have severe depression, eating disorders (bulimia or binge eating), health issues, and/or major illnesses/diseases will also be excluded. Major illnesses/diseases in the context of the present study includes any disease, illness, or chronic condition that may inhibit or negatively impact on participants' ability to safety engage in a minimal contact/support intervention, or engage in a low calorie diet and physical activity intervention. Example conditions are: diabetes, heart disease, cancer, or some mental health conditions that would inhibit the participant's health or ability to engage in the program safely with minimal support and supervision. Participants on anti-depressant medication may be excluded. In addition, any individual with past major operations in the last two years, or with any upcoming major operations, or cardiovascular events in the last six months will be excluded. Participants who consume opioids or regularly have more than two alcoholic drinks per day will also be excluded.

Appendix I: HEALTHI Program Orientation Invitation Letter

Orientation Session Invitation

Dear _____,

CONGRATULATIONS and welcome to the HEALTHI Program!

You have made an important decision towards your weight loss and health goals, and I look forward to getting you started on your path to success!

This letter is to confirm your booking to attend the **HEALTHI Program Orientation Session.** I look forward to meeting with you and providing you with detailed information about the program.

Any changes to the appointment details listed below need to occur within 48 hours.

Orientation Session

Date:	_____
Time:	_____
Address:	Curtin University. Kent Street, Bentley.
Location:	*Interprofessional Health and Wellness Centre*
Building number:	404
Clinic:	Please present to reception.

Getting to Curtin University.

Public Transport Information:

- Trains and buses make it easy to get to and from Curtin University. For more information please contact the Transperth InfoLine on 13 62 13 or go to www.transperth.wa.gov.au

Parking Information:

- A parking permit has been included with the letter. Please display the permit on your car windscreen with the correct date. The parking permit will allow you to park in parking bays B6 and B7 free of charge (Hayman Road).
- *Please view the attached map for parking bay location information.*

If you have any further questions please do not hesitate to contact me on weightloss@curtin.edu.au or 0456 103 197.

Kind Regards,
Anne Hattar
Registered Psychologist

Appendix J: HEALTHI Program Orientation Booklet Handout

[7]HEALTHI Program Orientation Booklet

Content

[7] Appendix J, format and font sizes have been adjusted to accommodate for the thesis page layout. Content page numbers do not reflect the corresponding thesis page numbers.

HEALTHI Program Overview	**Clinic Appointment**		
	Apt 1 Week 1	**Apt 2 Week 6**	**Apt 3 Week 12**
What do I need to do the WEEK before my appointment?			
Complete and submit the relevant online survey. (The time needed to complete the survey will depend on your individual requirements. On average the surveys may take between 30 to 40 minutes).	Getting to know you? **http://tinyurl.com/HEALTHIweek1** Enter survey using your registered name, mobile and the password: HEALTHI	Where are we at Week 6? **http://tinyurl.com/HEALTHIweek6** Enter survey using your registered name and mobile.	How did we go at Week 12? **http://tinyurl.com/HEALTHIweek12** Enter survey using your registered name and mobile.
Complete the 3 day food, drink, and exercise diary			
Attend pathology appointment within 3 days prior to Curtin clinic appointment. 12 hour fast required.			
What do I need to do the DAY BEFORE my appointment?			
Ensure you have fasted for 12 hours.			
Prepare to bring your 3 day food, drink, and exercise diary.			
Prepare light clothing, and minimal jewellery or metal clothing for tomorrow's body scan.			
Prepare to bring your signed consent form to the initial appointment.			
What to expect at my Clinic Appointment?			
Measures taken including weight, waist-hip circumference, and blood pressure.			
Undertake body composition scan.			
Provided with your FREE copy of the Calorie Counting book and diary.			
Engage and receive the HEALTHI Program.			
How long will the appointment take?	3 hours (including intervention)	30 minutes	45 minutes

Participant Information Sheet

Dear Participant,

My name is Anne Hattar, a Registered Psychologist, and a Postgraduate research (Clinical Psychology) student from Curtin University. I would like to invite you to participate in the HEALTHI Program, which is a research study regarding weight loss and health benefits that I am conducting as part of my thesis.

PURPOSE OF THIS RESEARCH

This research is investigating the effectiveness of providing information and using a psychological theory based intervention to assist in weight loss. The study seeks the participation of individuals between 18 to 65 years of age, who are overweight or obese, and have a reliable mobile phone with text messaging ability.

WHAT PARTICIPATION INVOLVES

- Watching a video presentation with weight loss information;
- Receiving a free copy of the Calorie King book and Calorie Counting Journal;
- Completing tasks, including a food, drink and exercise diary;
- Completing questionnaires prior to, and during the program;
- Attending 3 appointments at Curtin Clinic for measurements and other testing;
- Before each clinic appointment, attend your Pathology appointment.
- At the first and last clinic appointment complete a body scan referred to as the Dual-energy X-ray absorptiometry; and
- All participants will go into a draw to receive a $100 Coles Myers Voucher. You will automatically be entered into the completion provided that you complete the 12 week program. This includes attending all clinic appointments and completing the required questionnaires and measures. Please refer to the attached competition terms and conditions.

YOUR PARTICIPATION IS VOLUNTARY

Your involvement in the study is entirely voluntary and your non-participation or decision to withdraw may be done freely at any time. If you decide to participate and change your mind later, you may withdraw from the study at any time without any negative consequences for yourself.

POTENTIAL RISKS

This program is aimed to lead to weight loss and health benefits. A potential risk is that no weight loss or health benefits are experienced, and no guarantee can be given that you will benefit from the program. However, following the study's completion, you will be provided with the opportunity to receive further information about the study results regarding weight loss.

Please be aware, that physical exertion may involve some risks. For this reason, it is requested that physical activity levels are gradually increased and that you are to consult your general practitioner if you have any concerns or questions.

Blood Sample

You will be required to attend a Pathology appointment to undertake blood samples on three occasions by a trained phlebotomist. Please ensure you fast for 12 hours and that the provided request form is with you when attending your appointment.

Dual-energy X-ray absorptiometry
The Dual-energy X-ray absorptiometry (DEXA) scan will be completed on two occasions by a trained personnel. Whilst undergoing the DEXA scan you will be required to wear minimal clothing and to remove any metal or jewellery. The DEXA scan entails exposer to a small amount of ionising radiation, however the exposure is very small, with effective radiation doses of < 5 microsieverts (an effective dose during an 8 to 10 hour aeroplane flight is of the order of 60 microsieverts) hence, the equipment is safe to use. That is, the radiation received during a scan is less than that of an airline flight from Perth to Brisbane. It is approximately 1/10 that of a standard chest X-ray. There is no discomfort associated with the measurements. At your request, you can receive a copy of the results of your scan that you could discuss with your doctor should you wish to do so.

CONFIDENTIALITY
Your personal information will remain anonymous and confidential. Access to your information will only be viewed by myself, my research supervisors, and research assistants. The information provided will be used for the specified research study, and potentially other research in the area of weight loss. Copies of questionnaires and other written material will be stored in a locked cabinet in the School of Psychology or in an electronic form for fifty years, and then destroyed. If the study is published, you will not be identified.

Your DEXA scan data will be stored, linked to your name and other biographical data such as your date of birth, height and weight on the DEXA computer. Access to this data will be password protected and limited to the researchers, and possibly a small number of relevant support personal involved with operating the equipment and data backup. Data extracted from the DEXA computer for analysis and reporting will not be linked to names to preserve confidentiality. Further, it is a legal requirement (Radiation Safety Act, Section 36: point 2.4) that records are maintained of the name, age, date and type of examination undertaken on the DEXA equipment and these records shall be available for inspection by officers of the (Radiological) Council. Therefore a register of volunteers scanned including this information and the study they are participating may be maintained for the Radiological Council. The register will be stored in a locked room within the Physiotherapy Clinic where the DEXA equipment is located.

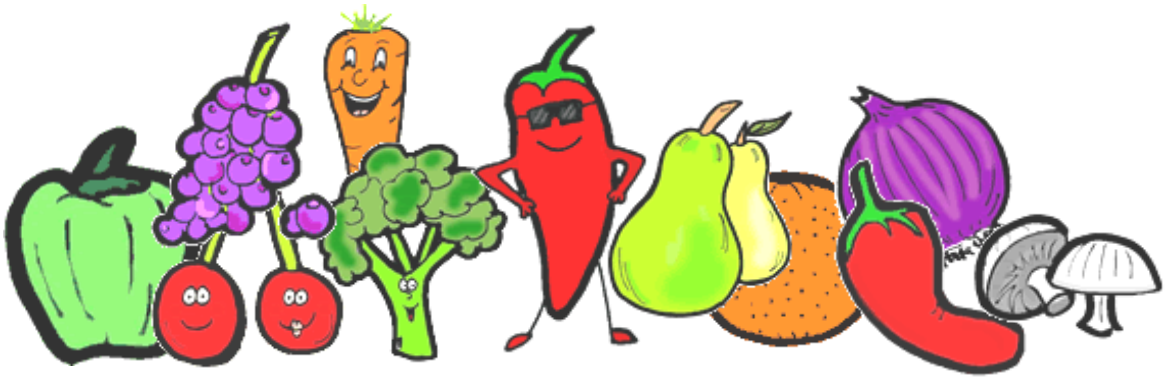
ETHICS APPROVAL
This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HR 137/2013). The Committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784 or by emailing hrec@curtin.edu.au

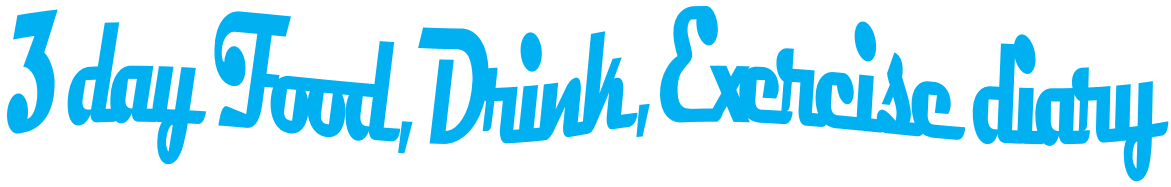
FURTHER INFORMATION
Thank you for taking the time to read the provided information. If you would like to arrange for your participation in this study, have any questions, or would like more information please contact Anne Hattar via email on weightloss@curtin.edu.au or mobile 0456 103 197. Alternatively, you can contact Anne's supervisors: Dr Sebely Pal on 9266 4755 or s.pal@curtin.edu.au; or Dr Martin Hagger on 9266 2215 or martin.hagger@curtin.edu.au

HEALTHI Program – Competition Terms and Conditions

1. Instructions on how to enter and other details contained within promotional advertisements for this competition form part of the conditions of entry.
2. By entering the competition, entrants agree to abide by these Terms and Conditions
3. The Terms and Conditions of this competition are governed by the laws of the State of Western Australia.
4. The competition is being run by Curtin University, GPO Box U1987, Perth, Western Australia, 6845 ("Curtin").
5. The HEALTHI Program competition ("the competition") commences at 9am Australian Western Standard Time (AWST) on Monday, 16 June 2014.
6. The closing time for entering the competition is 9am AWST on Tuesday, 05 January 2016, OR after all participants have completed the HEALTHI Program.
7. Entry to the competition is limited to participants who complete the HEALTHI program, attend all the clinic appointments, and engage in completing the required questionnaires and measures.
8. To enter the competition, the entrant must:
    (a) Participate in the HEALTHI Program.
    (b) Complete the HEALTHI Program by attending all clinic appointments and engaging in completing the required questionnaires and measures.
    (c) If condition (a) and (b) are met then a participant is automatically placed in the completion.
9. Entry to the competition is free.
10. Entrants may only enter the competition once.
11. There will be one (1) prize. This prize will be a $100 Myers/Coles gift voucher.
12. There will be one (1) draw at 9am Australian Western Standard Time on Tuesday, 05 January 2016, OR after all participants have completed the HEALTHI Program. The draw will take place at Curtin University. The draw will be by random number generator from all eligible entries received with the first entry drawn being the prize winner.
13. The prize winner will be contacted within seven (7) days of the draw by the mobile phone number supplied by the entrant on the HEALTHI Program demographic information form.
14. If the prize winner does not respond to claim the prize within twenty-one (21) days of the draw, a re-draw will be conducted within thirty (30) days of the original draw date, in the same location, and with the same method.
15. The prize winner will be responsible for all costs associated with collecting and using the prize.
16. By entering the competition the entrant agrees that they are over the age of 18 years.
17. The prize is not redeemable for cash or an alternative prize.
18. The prize is not transferrable.
19. Curtin is not responsible in any manner whatsoever for any problems or any financial costs incurred, or any combination thereof, including any injury or damage to participants or any other persons related to or resulting from participation in this competition.
20. Curtin accepts no responsibility and shall not be held legally liable or responsible for any accident, loss, injury or damage to any individual or property whether direct or indirect, whether in contract, tort, negligence or otherwise arising out of or in connection with the competition or the prize, either during or after the competition.
21. Entry into the competition signifies acceptance of all conditions. Entrants are required to abide by the Terms and Conditions as presented.
22. Curtin's decision will be final and no correspondence will be entered into.
23. Personal information provided by an entrant to Curtin for the purpose of entering the Competition will be collected, used and disclosed in accordance with Curtin's Privacy Statement. A copy of the privacy statement is available at http://global.curtin.edu.au/legal/privacy.cfm. Personal information collected will be kept strictly confidential and will not be sold, reused, rented, loaned or otherwise disclosed to any third party otherwise than in accordance with the Curtin privacy statement and these Terms and Conditions.

Food, Drink, and Exercise Diary





How to use your Food, Drink, and Exercise Diary?

Recording Food Intake

It is really important that you accurately **record everything** that you **eat** and **drink** for **three consecutive days**. One of these days needs to be a weekend, and two of the days a weekday. That means the best time to complete your food record is Thursday to Saturday, or Sunday to Tuesday. Start a new page for each of the days and remember to date it! ☺

Time Record the time you eat. Each day begins at 12 midnight.

Location Record the location of each meal, snack, and drink. For example, home, work, school, restaurant.

Amount Record the amount of food and liquid consumed.

- For liquids record cups, glasses, ml or L. Liquids include water, juice, coffee, milk, tea, soft drinks, and alcohol. Please record if you used sweeteners.
- For foods record the weight of food in grams as much as possible. Tablespoons, teaspoons, standard servings (e.g. one slice bread or

small apple), and approximate dimensions is helpful. Specify whether the food is lean, fatty, diet, light, and so on. Weigh food before cooking when possible. (Indicate if the food was weighted before or after cooking).

Description and Method Preparation

- Identify if food is fresh, frozen, canned, unsweetened, sweetened, etc.
- Designate milk as whole, 2% low fat, skim, non-fat, or chocolate, etc.
- Identify cut of meat or poultry (e.g., chicken) or type of fish. Record if there was skin or fat.
- For prepared food identify brand and/or describe ingredients. For example, "Oatmeal cookies with raisins," or "Kelloggs cornflakes" rather than just writing cornflakes or dry cereal.
- Describe method of preparation (fried, baked, boiled, stewed, grilled, steamed etc.).
- Record any additional ingredients used in cooking.
- For homemade, prepared foods, describe ingredients and amounts.
- Think of each meal in terms of individual foods and record each one separately. For example a ham and cheese sandwich is: 2 slices white toast bread, 1 piece ham, 1 slice coon cheese.

Accuracy Each day, circle the % accuracy which you think describes your record. Leave additional comments if you would like to explain why your record is inaccurate, or if you wish to provide further information.

Example Below is an example of how to report food intake using the food diary.

Time	Location	Amount / Quantity	Description & Method preparation
7:00AM	Home – Breakfast.	2 medium sized eggs. 5g of Coles Canola Oil. 1 slice of Coles white toast bread. 1 teaspoon of Master Food Tomato sauce.	Eggs were fried using the oil. No salt added. Bread eaten plain.

Recording Physical Activity

It is really important that you accurately **record all** participation in **physical activity** for **three consecutive days**. One of these days needs to be a weekend, and two of the days a weekday. That means the best time to complete your food record is Thursday to Saturday, or Sunday to Tuesday. Start a new page for each of the days and remember to date it! ☺

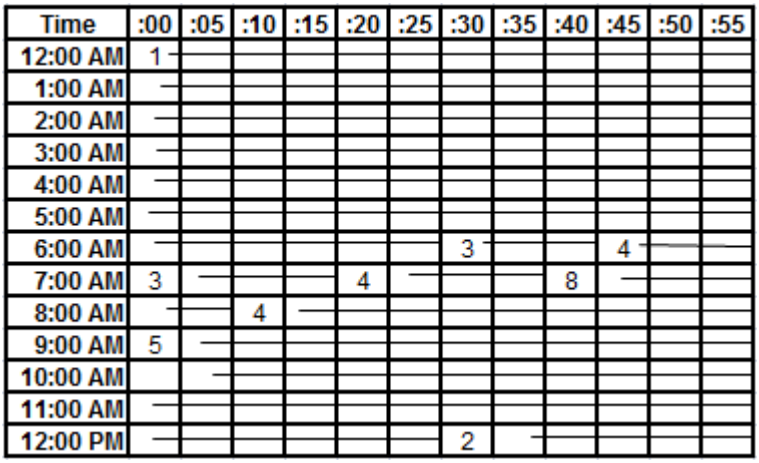
Time In each box, next to the correct time record the activity code that corresponds to the physical activity you carried out during each 5 minute period.
If an activity is carried out over a long period of time (for example sleeping) then you can draw a continuous line in the rectangular boxes until there is a change in activity. Please refer to the example to help you understand this better.

Activity Use the activity coding list to accurately record the number that reflects the type of physical activity you completed.

Activity Code	Example of Activity for each code	
1	Lying down	Sleeping, resting in bed.
2	Seated	Sitting, listening in class, eating, writing by hand or typing, taking a bath, reading, listening to the radio or T.V.
3	Light standing activity	Washing oneself, shaving, combing hair, dusting, and cooking.
4	Light moving activity	Slow walk (strolling), driving a car, getting dressed, taking a shower.
5	Light manual work	Housework (washing windows, floor sweeping ect.), tailor, baker, labour work, painting, waiting on tables, nursing chores, doing the bed, moderately quickly walking (going to school, shopping).
6	Light sport of leisure activities	Baseball, table tennis, golf, croquet, sailing, cycling (leisure), volleyball, canoeing or rowing, archery.
7	Moderate manual work	Carpentry, house building, wood cutting, loading and unloading bags or boxes.
8	Moderate sport or leisure activities	Badminton, cycling (race bike), dancing, tennis, jogging (slow running), swimming, horseback riding, brisk walking.
9	Intense manual work: Intense sport or leisure activities:	Cutting tree branches. Running in a race, squash, basketball, football.

Accuracy Each day, circle the % accuracy which you think describes your record. Leave additional comments if you would like to explain why or wish to provide further information.

Example A number 1 was recorded at the 12:00 time. A continuous line was drawn from the 12:00AM time to 6:25AM. This indicates that during the hours of 12:00AM to 6:25AM the individual was sleeping and/or resting in bed (activity code was 1). At 6:30AM a number 3 was recorded with a continuous line ending at 6:40AM, indicating the individual was standing (activity code 3) from 6:30 to 6:40AM.



Name: _____ Date: _____ Week: ___

Circle the best answer from each line:

Today is Consecutive Day number: 1 2 3

Day of the week: Mon Tue Wed Thur Fri Sat Sun

For today's date this is page: 1 of 1; 1 of 2; 2 of 2; 1 of 3; 2 of 3; 3 of 3; _____.

Food and Drink Intake recorded starting from midnight.

Time	Location	Amount / Quantity	Description & Method preparation

Accuracy of Food Consumption:

%: 0 10 20 30 40 50 60 80 90 100 accurate

If today's food intake log was inaccurate, please describe:

_____

List the name and amount of any vitamins, supplements, and/or medication you are taking?

_____

_____

Name: _____ Date: _____ Week: ___

Circle the best answer from each line:

Today is Consecutive Day number: 1 2 3

Day of the week: Mon Tue Wed Thur Fri Sat Sun

For today's date this is page: 1 of 1; 1 of 2; 2 of 2; 1 of 3; 2 of 3; 3 of 3; _____.

Physical Activity Participation Log

Time	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
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11:00 PM												

Accuracy of Physical Activity Log:

%: 0 10 20 30 40 50 60 80 90 100 accurate

If today's physical activity log was inaccurate, please describe:

_____

_____

Activity Code	Example of Activity for each code	
1	Lying down	Sleeping, resting in bed
2	Seated	Sitting, listening in class, eating, writing by hand or typing, taking a bath, reading, listening to the radio or T.V.
3	Light standing activity	Washing oneself, shaving, combing hair, dusting, cooking.
4	Light moving activity	Slow walk (strolling), driving a car, getting dressed, taking a shower
5	Light manual work	Housework (washing windows, floor sweeping etc.), tailor, baker, labour work, painting, waiting on tables, nursing chores, doing the bed, moderately quickly walking (going to school, shopping).
6	Light sport of leisure activities	Baseball, table tennis, golf, croquet, sailing, cycling (leisure), volleyball, canoeing or rowing, archery
7	Moderate manual work	Carpentry, house building, wood cutting, loading and unloading bags or boxes
8	Moderate sport or leisure activities	Badminton, cycling (race bike), dancing, tennis, jogging (slow running), swimming, horseback riding, brisk walking.
9	Intense manual work: Intense sport or leisure activities:	Cutting tree branches Running in a race, squash, basketball, football

How to keep a Food Record

GENERAL HINTS

- ✓ Include **3 consecutive days of your food intake**, consisting of 2 week and 1 weekend day.
- ✓ Record **all foods and drinks** that are being consumed over the 3 days.
- ✓ Each day begins at **12 midnight.**
- ✓ Record the food **immediately** after consuming it, don't wait until the end of the day as it's easy to forget snacks, drinks etc.
- ✓ Remember to include **brand names** of products, **cooking methods**, and **quantities** consumed as accurately as possible.
- ✓ If possible, write down the KJ or Calorie content of any frozen or pre-prepared meals, e.g., Lean Cuisine, meal replacements etc.
- ✓ Please provide **food labels or nutritional value information** of foods consumed if possible.

REPORTING THE AMOUNTS OF FOOD

- ✓ Please **weigh** everything if possible.
- ✓ Ensure that the **raw weight** of food is reported where possible. If not, indicate that cooked weight was reported.
- ✓ If food cannot be weighed, use **metric measures** (teaspoon, tablespoon or cup) or **dimensions** to describe amount of food. *For example: 1 tablespoon of honey, Grilled T-bone steak (5cm thick x7cmx10cm).* Please find portion size estimation at the end of this document.
- ✓ When a meal is made up of several food items, **each item** needs to be weighed and recorded in detail separately. See example of the beef and salad roll in food record.
- ✓ When cooking from recipes, please provide us the **recipe** (quantities and ingredients). Also state how many **serves** the recipe provides and how many serves of that recipe you **consumed**. See example of cheese sauce in Section G).

WHAT TO DO WHEN EATING OUT

- ✓ It is **OK** to eat out if this is your usual lifestyle.
- ✓ Report as much detail on your meal as possible.
- ✓ Use **metric measures** or **dimensions** of food to describe portion sizes, e.g., bread roll 30 cm;
- ✓ If a mixed dish is consumed of which you do not know the exact ingredient, then provide the **menu description of the dish** and indicate the portion size of the entire meal using metric measure;
- ✓ Remember to report all **beverages** consumed. For example: 2 glasses of cabernet – please state if small, medium or large if you are unable to measure it.
- ✓ Include dinner rolls (with spreads), desserts, tea and coffee and after-dinner mints.

DESCRIBING YOUR FOODS

A) Breads

Example: Helga's light rye bread (40g); Vitalite canola margarine (10g); IXL strawberry jam (20g)

✓ Report **brand names**
✓ Identify **types (***E.g.: white, multigrain, wholemeal or continental breads)*
✓ Report **weight** of breads prior to toasting
✓ Describe **spreads** added (*E.g.: margarine, peanut butter, jam, honey)*

B) Cereals
Example: Kellogg's All Bran (40g); Light Start Reduced Fat milk (200g); Sugar (20g)

✓ Report **brand names**
✓ Describe **milk and sugar**, if added to breakfast cereals
✓ Report **weight** of cereals prior to cooking (*E.g.: oats*)

C) Pasta, rice and noodles
Example: Barilla wholemeal pasta, boiled (100g); Bertolli virgin olive oil (20g)

✓ Identify **types** (*E.g.: white or brown rice, long grain, basmati, wholemeal pasta).*
✓ Report **weight** prior to cooking
✓ Report specific **cooking methods** (*E.g.: Sunrise long-grain white rice steamed)*
✓ Indicate amount and type of **oil/fat** added to rice, pasta and noodles

D) Fruits (including juice)
Example: Golden Circle tropical fruit salad, canned, in natural juice, not drained (100g); Red apple, cored and peeled (50g); Berri orange juice, unsweetened (100g)

✓ Identify if fresh, frozen, canned, sweetened or unsweetened
✓ Indicate whether canned fruit is in heavy/light syrup, natural juice, drained or undrained
✓ Indicate if peeled or unpeeled

E) Vegetables
Example: McCain's frozen baby peas, boiled (100g); Devondale butter (20g)

✓ Identify if fresh, frozen, canned
✓ Report the **weight** prior to cooking (raw weight)
✓ Report specific **cooking methods** (*E.g.: steamed, boiled, fried with oil)*
✓ Indicate amount and type of **oil/fat** added

F) Milk
Example: Light Start reduced fat milk (200g); Master's light chocolate milk (500g); Tea (100g); Pura Hi-Lo milk (1.4% fat) (20g); Sugar (5g)

✓ Report brand names of products used.
✓ Identify milk as full cream, 2% fat (Hi Lo), skimmed/non-fat, flavoured (chocolate, coffee etc.)
✓ Report milk added to hot beverages

G) Yoghurt and cheese
Example: Ski Diet strawberry yoghurt (200g); Cheese sauce (serves 4, had 1); Mainland's cheddar cheese (110g); Light Start reduced fat milk (600g); Butter (40g); Plain flour (40g)

- ✓ Indicate whether yoghurt are *diet*, *low-fat*, *with fruit* or *without fruit*
- ✓ Report yoghurt or cheese added to cooking

H) Meat
Example: T-bone steak, bone-intact, fried (200g) Bertolli olive oil (50g); ETA vegetable oil (50g); Gravox mushroom gravy mix (20g); Water (50g); Chicken breast fillet, crumbed, fried (100g)

- ✓ Indicate the **cuts** of meat used
- ✓ Be sure to indicate whether bone is present and whether visible **fat and skin has been removed**
- ✓ **Report the** weight **prior to cooking (raw weight) & make a note that it is the raw weight**
- ✓ Indicate amount and type of **oil/fat** added. For example: chicken crumbed and deep fried with 30ml of Crisco canola oil
- ✓ Indicate what type of **cooking method** was used to prepare meats. For example grilled or BBQ T-bone steak.
- ✓ Specify whether **gravy or other sauces** are added to meat dishes

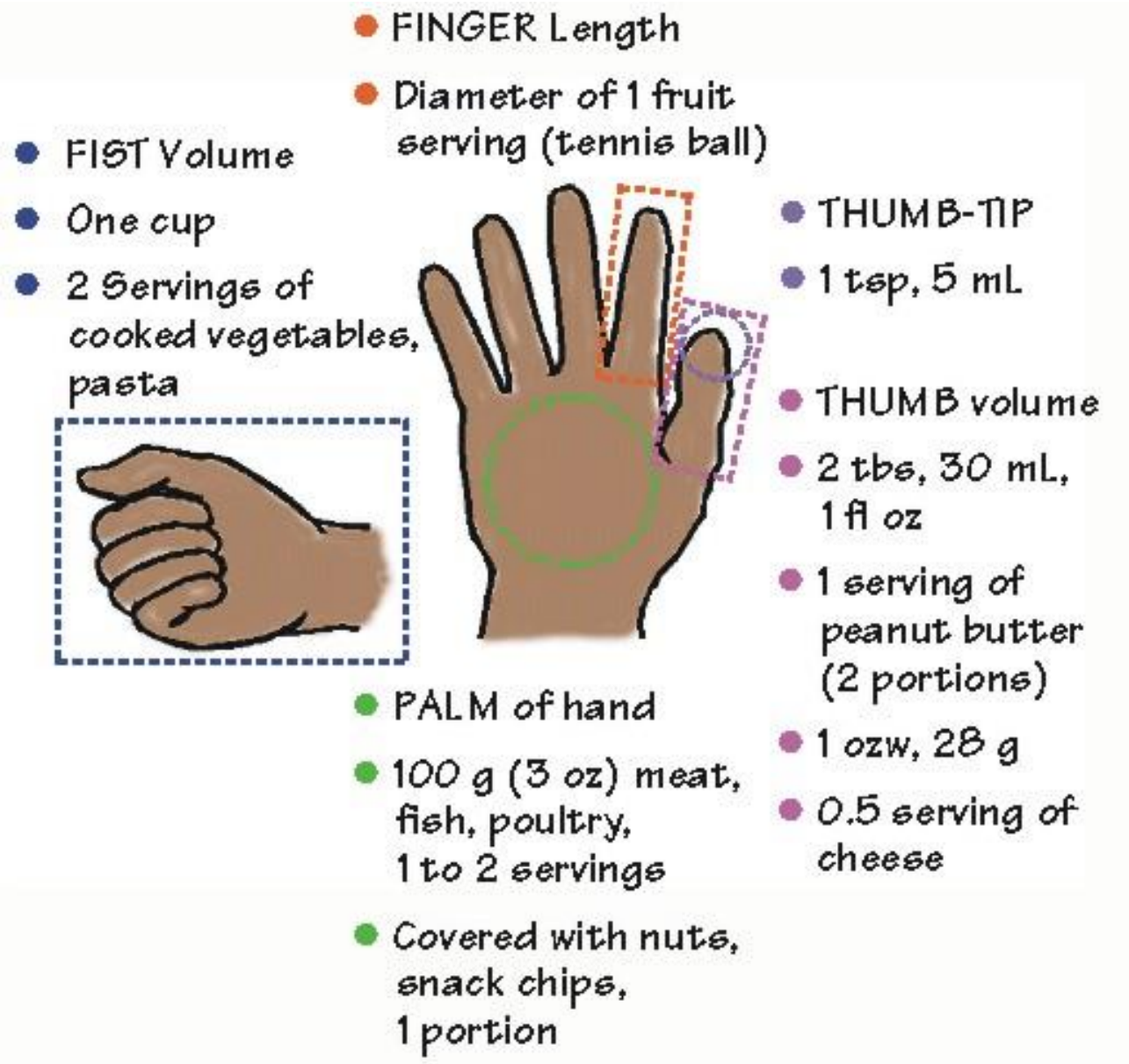
I) Nuts and Legumes

- ✓ Indicate if legumes are dried, fresh, frozen or canned
- ✓ Indicate if nuts are roasted, salted, raw, chocolate-coated or candied

J) Extra foods
Example: Pizza Hut Meat Lover's pizza, thick crust (200g); McDonald's Big Mac, extra cheese (200g)

- ✓ These include all snack foods, fast foods, pies, pasties, pizza, fries, lollies, biscuits, cakes, pastries, ice-cream, sugar, oils
- ✓ Please provide food labels or nutritional value information of foods consumed where possible
- ✓ Include brand names of products
- ✓ Describe **flavour** and **variety** of fast food in detail
- ✓ Report **nibbles** and **snacks** as soon as you have consumed them so that you don't forget
- ✓ *Remember to report*: sugar and milk in tea and coffee; spreads on breads and crackers; dressings, gravies and oils added to salads and other foods.

Visual Tools to estimate portion size



[8] Name: _____ Date: _____ Week: ___

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_____

[8] This exact page was replicated another seven times on the consecutive pages.

[9]Name: _____ Date: _____ Week: ___

Circle the best answer from each line:

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9	Intense manual work: Intense sport or leisure activities:	Cutting tree branches. Running in a race, squash, basketball, football.

[9] This exact page was replicated another three times on the consecutive pages.

CONSENT FORM

- I have read the participant information sheet and have been given the opportunity to have any questions answered.
- I acknowledge that I understand the purpose of the study.
- I agree to participate in this HEALTHI Program study, however understand that my participation is voluntary, and that I can have a change of mind and withdraw from the study at any time without any negative consequences.
- I understand that the studies result may be published; however no personal or confidential information will be used to identify me.
- I agree that I will not participate in any other weight loss program or intervention while I am participating in this study.
- I commit to attending a Pathology appointment prior to attending each of the Curtin clinic appointment.
- I approve of undertaking the body composition scans referred to as the Dual-energy X-ray absorptiometry (DEXA) as was outlined in the participant information sheet. I understand that I will be exposed to minimal amounts of radiation (effective radiation doses of < 5 microsieverts) when undertaking the DEXA scan.
- I have read the HEALTHI Program competition Terms and Conditions and provide my consent to be bound by them.

Participant Name: _____

Participant Signature: _____ Date: _____

Researcher: Anne Hattar

Researcher Signature: _____ Date: _____

Appointment Letter Confirmation

Dear _____,

Congratulations on being a part of the HEALTHI Program study.

Before attending your appointment:

- Attend Pathology appointment within three days of your Curtin Clinic appointment. You are required to fast for 12 hours from all food and drinks. Ensure the provided request form is with you when attending your appointment.
- Fast for 12 hours from all food and drinks prior to this Curtin clinic appointment.
- Complete the relevant online survey using the below details:

Survey name: Week 1: Getting to know you
Survey link: http://tinyurl.com/HEALTHIweek1
Password: HEALTHI

Please **bring** the following to your appointment:

- Completed copy of the 3 day food, drink and exercise diary.
- Consent form (signed); and
- Prepare light clothing, and minimal jewellery or metal clothing for the body scan.

Your **appointment details** are as below:

Date:	_____
Time:	_____
Address:	**Curtin University of Technology, Kent Street, Bentley.**
***Location*:**	**Building 404. *Interprofessional Health and Wellness Centre***
Clinic:	**Please present to reception**

Public Transport Information: Trains and buses make it easy to get to and from Curtin University. For more information please contact the Transperth InfoLine on 13 62 13 or go to www.transperth.wa.gov.au

Parking Information: The parking permit allows you to park in parking bays B6 and B7 free of charge. Please display the permit on your car windscreen with the correct date. Please view the Curtin map for parking bay location information.

If you have any further questions please do not hesitate to contact me on weightloss@curtin.edu.au

Kind Regards,
HEALTHI Program

Appendix K: HEALTHI Program Summary Handout

HEALTHI Program Summary

HEALTHI Program Guidelines

Each day try your best to achieve the following two guidelines.

PHYSICAL ACTIVITY: Engage in physical activity and be as active as possible. Engage in a minimum of 30 minutes of planned daily exercise.

DIETARY ENERGY INTAKE: Monitor your energy intake and ensure your calorie (or kilojoule) intake amount is somewhere in-between the minimum and maximum allowance amount.

- The HEALTHI Program guidelines are to be set at the start of each day for the next 12 weeks. If for any reason you do not meet them on a certain day, then try your best to continue the day by trying to meet the guidelines, and just start again the next day. **Learning from your past mistakes and moving forward is the best way to achieve your weight-loss and health goals.** Each day is a new beginning. Remember, even the small choices you make each day can help contribute to a larger result and take you a step closer to your goal.

- The guidelines are there to assist you to lose weight. Try and focus on following these guidelines, and avoid constantly weighing yourself. **Sometimes even when the numbers on the scale are not moving it does not mean that you have not contributed positively to your goals.** Although it can feel frustrating when no weight change has occurred, if you are following the guidelines then there can be another explanation. It could be that you have increased your muscle or water mass. Also even with no weight

change, if you are following the guidelines then you may be contributing to better health such as reducing obesity-related risk factors.

Physical Activity Information

- When we talk about 'physical activity' we usually mean any type of activity that requires sustained and repetitive muscle movements, such as things you do in everyday life, like walking, housework, and going up and down the stairs. Exercise is a specific form of physical activity that is planned and done with the intention to increase fitness levels or gain health benefits. For example, cycling, swimming, and running.

- **The HEALTHI Program suggests you try to remain physically active, and plan a minimum of 30 minutes of planned exercise each day.** If you miss a day, then try to reach the guideline the next day and start again. You are not expected to make up for the days that you missed. Of course, if you ever want to exercise more than 30 minutes on any given day that's fine!
- We suggest that you start and end your exercise session with a few minutes of light intensity exercise to warm your body up and cool down, however **for the majority of your exercise session try to engage in moderate to vigorous exercise intensity.**

- Your food, drink and exercise diary has a list of some planned exercise activities you may want to complete. Try and take on the activities that have higher numbers allocated to them as these activities are higher in intensity and so they may be more beneficial to assist with your weight-loss. For example, the activities under code 9 will be more intense exercise activities compared to the lower numbered activities.
    - If there is an exercise you would like to do that is not included in the table please contact the researcher to ask what code the activity may fall under. You can make contact in person or via email (weightloss@curtin.edu.au).

- Although it is better if you try to do the 30 minutes of exercise in the one setting, if you are unable to then there are a few options to help you to get there. For example, building up your fitness levels (walk at a slow pace and try to increase the pace thereafter), or divide the 30 minute exercise block throughout your day (exercise in blocks of ten minutes three times a day, and as your fitness levels increase then you can also increase the exercise time blocks to get you to the goal of a 30 minute block).
- If you have medical conditions, experience any concerns or difficulties when exercising, or require some expert advice in relation to what exercise intensity is right for you, then please contact your doctor or a professional exercise specialist to provide you with support given your individual requirements.

How to determine your exercise intensity level?

Light exercise intensity feels easy to do.	*Moderate exercise intensity* feels somewhat hard.	***Vigorous exercise intensity* feels challenging.**
No noticeable changes in your breathing pattern.	Breathing pattern quickens, however you are not out of breath.	**Breathing pattern becomes rapid and deep.**
No sweat resulting from the exercise (excludes sweat from hot or humid weather).	A light sweat results from exercise, after approximately 10 minutes of exercising.	**A sweat results from exercise, after a few minutes of exercising.**
Able to carry on a full conversation or sing.	Able to carry on a conversation, however you are unable to sing.	**Not able to carry on a conversation. May only be able to say a few words before pausing for breath.**

Dietary Intake Information

- Foods/drinks contain a different amount of energy intake which is measured using the units of calories (Cal) or kilojoules (KJs).

  Converting Calories to Kilojoules

  1 Cal = 4.2 KJs

  Food/drink (in Cal amount) x 4.2 = KJ content in the food/drink

  Converting Kilojoules to Calories

  1 KJ = 0.24 Cal

  Food/drink (in KJ amount) x 0.24 = calorie content in the food/drink

- Weight-loss can be achieved through calorie counting, however not all low calorie drinks and foods are healthier. **It is important to have a balance between meeting your calorie allowance amount and eating healthy.** To help you get this healthy diet balance refer to the Australian Dietary Guidelines.

- **Your calorie intake amount should be somewhere in between the minimum and maximum amount calculated for you based on your individual body needs.**
- The maximum calorie amount is the most calories that you can have on any given day to help you lose weight. The maximum amount is provided to ensure that you do not provide your body with too many calories, which would impact on your ability to lose weight. Also, please ensure you do not have less than the minimum calorie amount. One reason is to ensure your body will have enough energy for you to function.

- **Remember it is the small choices you make each day that will lead to a big difference.** If you go over your calorie allowance on a certain day, that is okay. Try your best to continue the day making healthy choices and not give up. **Reset the guideline the next day and start again!**

- It may help to plan in advance your breakfast, lunch, dinner, and snacks to make sure you spread your calorie allowance throughout your day. To ensure your calorie amount is sufficient throughout your whole day, it may mean you eat less of the high calorie foods you may have eaten in the past. Healthy foods usually contain fewer calories compared to junk food.

- It may be helpful to choose meals and drinks that have fewer calories. (Some meal and drink ideas are listed at the very end of this document). For example, by lowering your sugar and fat intake you can reduce your calorie amount.
    - This can be done by using reduced fat or light margarine spreads and oils. You can also avoid fried food and instead cook food using minimal fats and oils. This includes grilling, microwaving, and steaming. Also, you can choose lean meat cuts with minimal marbling, and chicken breast. Trimming off any visible fat and skin is also important.
    - You will find that by choosing a low sugar or reduced fat alternative for various foods and drinks will assist you in keeping your energy intake to a minimum, while you still enjoy the same food or drink. For example, a skim milk cappuccino has 70 calories, while a full fat cappuccino with whole milk is almost double the amount of calories, containing 125 calories. So in this way you can still have a cappuccino, but by choosing the lower fat version it means you are consuming half the amount of calories.

Drink intake?

- When it comes to drinks, water is the best option as it has zero calories. If we are looking at drinks from a calorie perspective, then the second best option is usually diet soft drinks that contain fewer calories, as compared to regular soft drinks or even some juices. For example, 600 ml diet coca cola contains 2.4 calories, and coca cola contains 258 calories.

- It is important to have a balance between calorie counting and healthy eating and drinking, as not all low calorie items are best for our health. So when looking at the drink options you may opt for an orange juice even though it has more calories (256 Cal per 600ML) compared to the diet coca cola soft drink (2.4 Cal per 600ML).

How to count calories?

- Monitor your energy intake by using either the measurement of KJs *or* Cal. Ensure you use the same type of unit measurement to prevent confusion. This information gives you an indicator of how much energy you will get from a serving of the food or drink product.
- **When we calorie count, the first choice is to use the nutrition labels or any item description information available to you that specifically displays the calorie amount such as wall menus or pamphlets. If neither of these things are available, then you will need to calculate the calorie amount using the *Calorie King* book.**
- If you are eating out, you may be given the calorie information or need to calculate it yourself.
    - Some places such as *Nandos*, *Boost Juice*, and *Subway*, will have a list of their foods or drinks and the calories that relate to the item. Sometimes, it is displayed on the wall menu of the shop, and at other times you may need to ask and the information can be easily provided.
    - At times you may need to calculate how many calories your food or drink has by estimating the portion of food and using your *Calorie King* book (such as when attending some fine dining restaurants). This may mean you need to examine the menu description or ask the waiter what food items are in the foods sauces or dressing to allow you to count the calories. Or, you can go without the dressing and not count it!

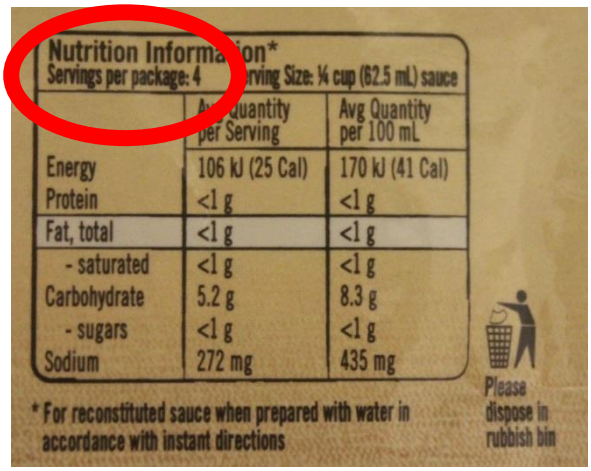
- Once you have worked out how many calories are in some of your favourite meals, then the next time you dine at the same place you already know how many calories the meal contains. An advantage of calorie counting is if you plan your food in advance, then you can still eat whatever you want! For example, if you want to have chocolate, then have it. Maybe you can have a lighter lunch to make up for the calories in the chocolate. Or maybe just have a smaller piece of chocolate then you usually do!

- If you cook for a family, calorie counting does not require you to make any changes when preparing the family's meals. For example, Sally cooks for her husband and child. She keeps a notebook handy in the kitchen, and with each added ingredient she looks at the nutrition label and writes down the corresponding energy content information in calories. She does this for each product and then calculates the total calorie amount within the family meal. She ends up eating only a quarter of the food amount she cooked. So, Sally divides the total calorie amount within the family meal by 4 to calculate the amount of calories she consumed.

- Packaged food and drink products have nutritional labels which contains product-specific information including serving size, calories, and nutrition information.
- The *Calorie King* book has a content and index page to allow you to easily calculate product information. To use the *Calorie King* book you may sometimes need to know how many grams the food item has. If you are cooking, then you can weigh the food using a scale while the food is raw. If the food has been cooked, say for example you are eating outside of your home, then you can estimate the food's weight by using a kitchen scale or the provided visual tool. (Within the orientation booklet, the Visual Tools handout provides information on how to visually estimate portion sizes).

How to read nutritional labels?

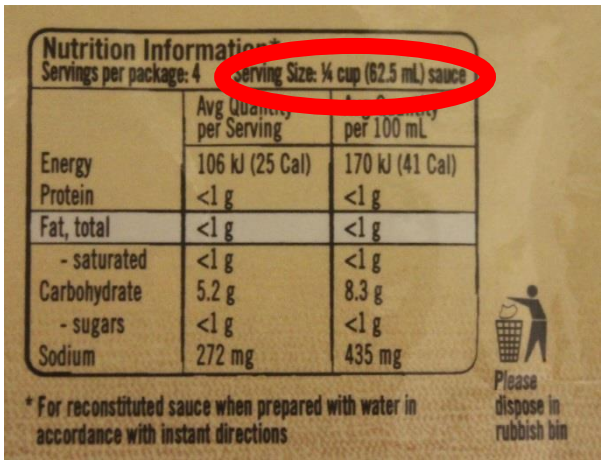
1. *Locate serving size and number of servings per package.* The first thing to look at is the serving size and the number of servings in the package. For example, a marination sauce product states the servings per package is 4, and each serving size is ¼ of a cup.



Nutrition Information* Servings per package: 4	Serving Size: ¼ cup (62.5 mL) sauce	
	Avg Quantity per Serving	Avg Quantity per 100 mL
Energy	106 kJ (25 Cal)	170 kJ (41 Cal)
Protein	<1 g	<1 g
Fat, total	<1 g	<1 g
- saturated	<1 g	<1 g
Carbohydrate	5.2 g	8.3 g
- sugars	<1 g	<1 g
Sodium	272 mg	435 mg

* For reconstituted sauce when prepared with water in accordance with instant directions

Please dispose in rubbish bin



Nutrition Information* Servings per package: 4	Serving Size: ¼ cup (62.5 mL) sauce	
	Avg Quantity per Serving	Avg Quantity per 100 mL
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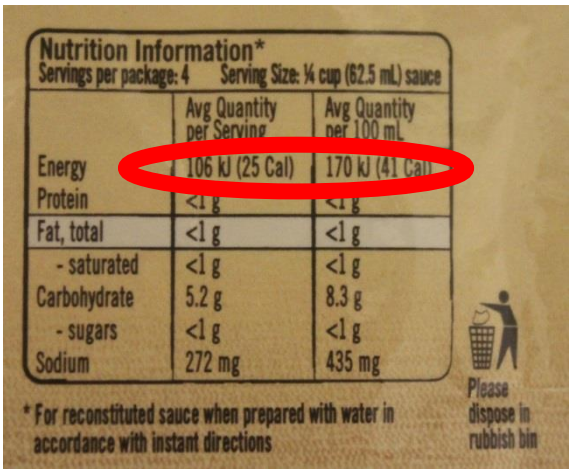
- saturated	<1 g	<1 g
Carbohydrate	5.2 g	8.3 g
- sugars	<1 g	<1 g
Sodium	272 mg	435 mg

* For reconstituted sauce when prepared with water in accordance with instant directions

Please dispose in rubbish bin

2. *Determine how many servings you are having.* Ask yourself how many servings am I having? (2, 1, or maybe half a serving). For example, the marination sauce product states that the servings per package is 4, and the serving size is a ¼ of a cup. So if I am going to eat half a cup worth, then I am having 2 servings worth.

3. *Number of calories per serving.* The next step is to look at the number of calories (Cal) or Kilojoules (KJs) per serving. Usually towards the top of the table, the number of Cal or KJs is displayed per serving, and per a familiar unit of measurement (such as a cup or 100 grams). For example, according to the nutrition information label each serving is 25 calories.



Nutrition Information* Servings per package: 4	Serving Size: ¼ cup (62.5 mL) sauce	
	Avg Quantity per Serving	Avg Quantity per 100 mL
Energy	106 kJ (25 Cal)	170 kJ (41 Cal)
Protein	<1 g	<1 g
Fat, total	<1 g	<1 g
- saturated	<1 g	<1 g
Carbohydrate	5.2 g	8.3 g
- sugars	<1 g	<1 g
Sodium	272 mg	435 mg

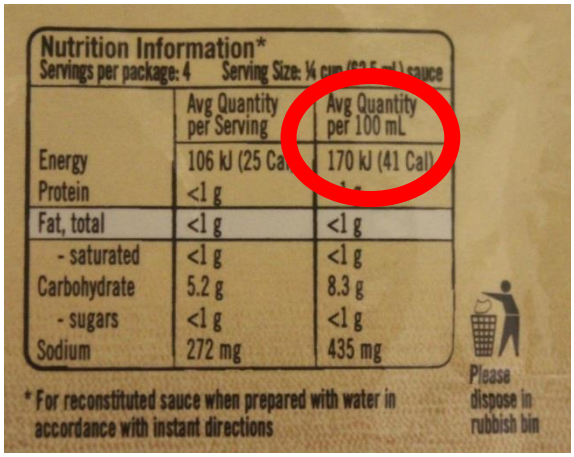
* For reconstituted sauce when prepared with water in accordance with instant directions

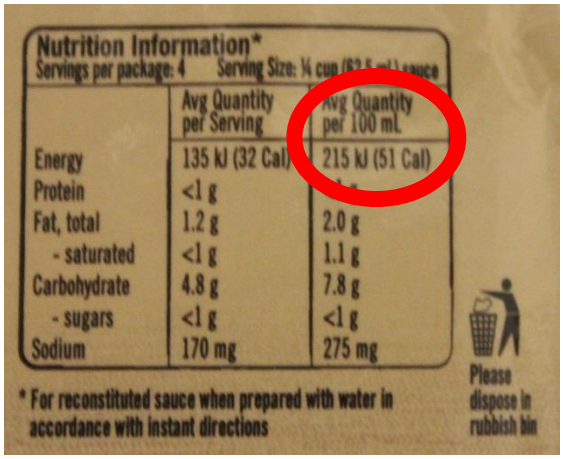
Please dispose in rubbish bin

4. *Determine how many calories you consumed.* The number of servings you have influences the amount of calories you have (calorie amount is calculated based on the portion amount you consumed). So you need to calculate how many calories you consumed. For example, according to the nutrition information label each serving of a quarter of a cup is 25 calories. I consumed half a cup of marination sauce, which is equivalent to 2 servings. So I multiply 25 calories by 2 servings. That is a total of 50 calories.

    ½ cup (1 serving) = 25 calories
    ½ cup (2 servings) = 25 calories x 2 = 50 calories.

    Note: The serving sizes allow us to make simple comparisons between similar types of foods; they are provided in units that are familiar; including a number of grams, cups, or pieces. For example, if one type of marination sauce has 41 calories per 100mL, and another type has 51 calories per 100mL, I can see which one of the two types of sauces has fewer calories.



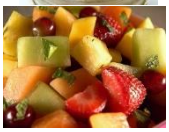


Recording your information

- Program requirements are that the week before each of your 3 appointments you:
    - Complete and submit the relevant online survey in advance.
    - Complete and bring in the 3 day food, drink, and exercise diary.

- What you can do to help you reach the guidelines?
    - Although, we do not need any more information from you (apart from that listed above), we strongly recommend that you record your exercise to help you remember what you have done, and record your food and drink intake to help you count up how many calories you have used each day.
    - Doing this would be for your own personal records to help you get to your goals! You may want to record this information using the same format as the 3 day food, drink and exercise dairy, or maybe use the calorie counting journal, or you may have another format that you prefer to use. We will not collect this information from you.

Meal Ideas

Meal	Description	Approx. Cal
Breakfast   	1 fried egg and 1 slice of wholemeal bread.	*218*
	2 large egg omelettes.	*225*
	2 Original Weet-bix biscuits, with 1 cup of skim milk and 2 spoons of sweetener (equal).	*210*
	Fresh fruit smoothie containing ½ cup of blueberries, 1 small banana, 80g low fat strawberry yogurt, and 200ml skim milk	*242*
	Low fat strawberry yogurt (160g tub) with ¼ cup muesli.	*245*
	Low fat flavoured yogurt (160g tub) with 10 whole almond nuts.	*224*
Lunch or Dinner  	160g grilled lean fillet steak, served with garden salad (1 tablespoon of 99% fat free balsamic salad dressing, 2 leaves cos lettuce, 5 slices green cucumber, and ½ medium tomato).	*350*
	150g grilled lean chicken breast, 30 grams chicken gravy sauce, and ½ cup basmati rice.	*255*
	200g cooked peeled prawns, served with 1 cup of mixed salad containing celery and cucumber.	*200*
	1 Fish fillet in cheese sauce (200g packet).	*245*
Snacks    	1 medium Apple, and 1 teaspoon of cinnamon.	*80*
	1 medium sized Banana.	*100*
	Mixed salad containing: 3 leaves cos lettuce, 10 slices green cucumber, ½ medium tomato, and 1 tablespoon of 99% fat free balsamic salad dressing.	*50*
	2 biscuits of Premium 98% fat free crackers, ½ medium tomato, and 1 tablespoon of French onion dip.	*100*
	1 cup of air popped popcorn without oil.	*30*
Desserts  	1 cup of fruit salad (melons, grapes, apple, and orange). Optional: Additionally add natural yogurt.	*150*
	1 cup or 250ml of diet jelly. (Jelly Lite brand).	*15*
	1 scoop of low fat ice-cream, with 26ml of Cottees diet chocolate topping.	*80*

Appendix L: HEALTHI Program Text Message Goal-reminder List

11 Goal-reminder Text Messages

One text message sent per week, to participants in the text message condition.

1. Hi ☺ I would like to remind you to review and remember your diet and physical activity goals. Have a look at your HEALTHI handout to see what you wrote down. Refer to these often to keep you on track.
2. Hope you are doing well. Just a friendly reminder that to reach your weight-loss goals, it is important that you remember what they are! Try and remember (or refer to your HEALTHI handout) your diet and exercise IF/THEN plans. Remember the when, where and how you will exercise and consume a specific amount of calories.
3. Hello ☺ I would like to ask you to take the time to review and remember your goals and the steps you need to take to reach them. Try and remember (or refer to your HEALTHI handout) when you imagined the steps for your diet and exercise goals when watching the video? Take a few minutes to imagine these steps to reach your goals so it is clear in your mind.
4. Hi there. Why not take the time to review and remember the when, where, and how aspects of your plans to diet and exercise. This will really help you reach your goals. Refer to your HEALTHI handout as remembering your goals will help you to take the steps to reach them.
5. Hello, hope you are well. Please review your IF/THEN plan you created in the area of exercise and diet that are within your HEALTHI handout. It will be extremely useful for you to review them to help you achieve your exercise and diet goals. Thank you.
6. Hi, before the end of your day, go through the HEALTHI handout and take the time to imagine yourself taking the steps needed to reach your goals that also includes the details of the IF/THEN plans. Do this for all your diet and exercise goals. It will help keep the steps clear in your mind.

7. Think about how your weight-loss is going. It is important to stick to your IF/THEN plans so that you can get the best results. Go back to these goals within the HEALTHI handout and review them.
8. Hello. Try and remember when you were in the clinic imagining how you would reach your diet and physical activity goals. Try to remember the steps you imagined and the 5 senses you experienced (touch, taste, hearing, sight, and smell). Use the HEALTHI handout to help you.
9. Try and remember your IF/THEN plans. Try to recall the cues or hints in your environment that will trigger you to remember the steps needed to reach your goal. For example, a certain time of the day, section of the day (e.g. meal time), an object, or situation. These cues will help you remember the steps you need to carry out to reach your goal. Refer to the HEALTHI handout to refresh your memory.
10. Using the HEALTHI handout, please read your diet and physical activity goals; imagine the steps needed to reach them, and your If/then plan. Refer to these often. Set some time aside to do this. It won't take long!
11. Today I would like you to review the HEALTHI handout and then take the time to imagine yourself taking the steps needed to reach your goals. When imagining the steps you should also include the details of the IF/THEN plans. Do this for all your diet and exercise goals.

Appendix M: Assessment Information and Score Ranges

Biomedical Outcomes

Body composition. Body weight (kg) has no descriptive information as problematic body weight is relative to height. According to the digital body composition monitor scale (Omron, model HBF 362), body fat percentage is categorised as low (female 5-19.9%, male 5-9.9%), normal (female 20-29.9%, male 10-19.9%), high (female 30-34.9%, male 20-24.9%), and very high (female 35-50%, male 25-50%). Waist-hip ratio scores estimate body fat distribution as research has shown that more weight around the waist indicates increased health risk; waist-hip ratio scores of $\geq$ .90cm for males, or $\geq$ .85cm for females indicated substantially increased health risk (WHO, 2008).

Blood pressure. Normal blood pressure is less than 120/80mmHg (systolic/diastolic), prehypertension is between 120-139/80-89mmHg (systolic/diastolic), high blood pressure stage 1 is between 140-159/90-99mmHg (systolic/diastolic), high blood pressure stage 2 is 160/100mmHg (systolic/diastolic) or higher, and hypertensive crisis is higher than 180/110mmHg (systolic/diastolic), (American Heart Association, 2016; Digital blood pressure monitor manual, Model UA 851).

Blood lipoproteins. The ideal range for each of the blood lipoproteins is listed. Low-density lipoprotein (LDL) is <3.5 mmol/L, high-density lipoprotein (HDL) is >1.0 mmol/L, total cholesterol (TC) is <5.5 mmol/L, triglycerides is <1.5 mmol/L, fasting glucose is between 2.5-5.4 mmol/L and fasting insulin is <12 mU/L. The cut-off criteria are based on the information provided on the Saint John of God

Pathology Centre pathology result form which was where the blood lipoprotein analyses were conducted.

Psychological Variables.

Psychological wellbeing. The Impact of Weight on Quality of Life Questionnaire had 31 items with total scores ranging from 31 to 155; higher scores indicated that weight had increased impact on the individual's quality of life (Kolotkin & Crosby, 2002). The Depression Anxiety Stress Scale (DASS-21) scores for the symptoms of depression, anxiety and stress are categorised by symptom severity level as illustrated in Table M1 below, (Lovibond & Lovibond, 1995).

Table M1

Depression Anxiety Stress Scale symptom severity levels

Severity	Depression	Anxiety	Stress
Normal	0 - 9	0 - 7	0 – 14
Mild	10 - 13	8 - 9	15 – 18
Moderate	14 - 20	10 - 14	19 – 25
Severe	21 - 27	15 - 19	26 – 33
Extremely severe	28 +	20 +	34 +

Note. Participant DASS21 scores were multiplied by two to provide the total score.

HAPA measures. Outcome expectancy included three items for each physical activity and dietary intake with each total score range from 3 to 15, with higher score indicating participants perceived that respectively, physical activity or dietary intake is effective to assist with reducing health risks related to weight gain. Two items were included for both the physical activity and dietary intake intention

scores which ranged from 2 to 10, with higher scores indicating the participants intended to respectively follow the physical activity or dietary intake recommendations. Five items were included for both the physical activity and dietary intake action self-efficacy score which ranged from 5 to 25, with higher scores indicating higher levels of perceived confidence and ability to engage in respectively, the physical activity or dietary intake guidelines. Maintenance self-efficacy scores for physical activity and dietary intake had nine items each and the total score ranged from 9 to 45, with higher scores indicating that despite barriers the individual is confident to engage in the guidelines of physical activity or dietary intake respectively. Action planning scores were derived from one item for both physical activity and dietary intake, with the total score range from 1 to 5, with higher scores indicating that the participant made a detailed plan about when, where, and how they will engage in the physical activity or dietary intake guidelines respectively. Motivation scores included three items for both the physical activity and dietary intake motivation measure, with the total score range from 3 to 18, with higher scores indicating participants had higher levels of motivation and effort to respectively, participate in physical activity or change their diet. Risk perception included four items and the total score ranged from 4 to 24 with higher scores indicating participants perceived that they have higher levels of developing obesity-related health risk factors.

Behavioural Outcomes

Nutrition and eating behaviour. Nutritional risk scores from the 25-Bailey Dietary Screening Questionnaire provide a possible total score from 0 to 105, with

lower scores indicating nutritional risk and higher scores indicting no risk (Bailey. 2005). The Three Factor Eating questionnaire (TFEQ) uncontrolled eating subscale had 9-items and the scores ranged from 9 to 36 (Stunkard & Messick, 1985). TFEQ cognitive restraint subscale had 3-items and the scores ranged from 3 to 12 (Stunkard & Messick, 1985). TFEQ emotional eating subscale had 6-items and scores ranged from 6 to 24 (Stunkard & Messick, 1985). For all the TFEQ subscales, the higher scores indicated more uncontrolled eating (tendency to lose control over eating when hungry or exposed to external stimuli), cognitive restraint (tendency to control food intake to influence body shape or weight) or emotional eating (tendency to overeat due to negative mood states) (Stunkard & Messick, 1985).

Energy intake and expenditure. Physical activity energy expenditure had no minimum or maximum score range, however higher scores indicated higher levels of energy expenditure or physical activity levels. Energy consumption through dietary intake had no minimum or maximum score range, however higher scores indicated higher levels of energy consumption through food or drink intake. Accuracy of physical activity and dietary intake log scores ranged from 0 to 100 percent, with higher scores indicating higher levels of self-reported accuracy when completing the physical activity and dietary intake log respectively.

Program compliance. Program compliance self-report items related to participants' beliefs about their compliance with the program guidelines of engagement in the physical activity and dietary intake weight-loss recommendations. Two items provided a total score for physical activity program compliance, and three items provided a total score for dietary intake program compliance. For example, one

of the physical activity program compliance scores stated “on average, during the past 6 weeks, how often did you engage in at least 30 minutes of planned exercise?” with score responses ranging from 1(never) to 5 (7 days/week or always). The possible score ranges are 2 to 10 for physical activity and 3 to 15 for dietary intake program compliance; higher scores indicated higher levels of compliance to the program guidelines.

Other measures

Body mass index. This measure takes into account body weight relative to an individual’s height; scores less than 18.5 indicate underweight, scores of 18.5 to less than 25 indicate normal weight, scores of 25 to less than 30 indicate overweight, and scores of 30 or more indicate obese weight range (WHO, 2008).

Imagery ability. This variable was measured using the Betts’ Questionnaire upon Mental Imagery total score which included 35-items. Possible score range is from 35 to 245, with lower scores indicating increased or high mental imagery ability (Sheehan, 1967).

Intervention checks. Intervention checks were also included to ensure participants engaged with the intervention activities and scores were coded by the researchers as described in detail within Appendix N. Goal setting intervention check scores ranged from 0 to 8. Implementation intention, process and outcome mental imagery intervention check scores ranged from 0 to 3.

Appendix N: Coding System for the Intervention Checks

Activity completed by all HEALTHI participants

Goal setting for physical activity and dietary intake

1. Each component of the SMART goals was provided with one point. These components include: Specific = 1, Measurable = 1, Attainable =1, Realistic = 1, and Time targeted = 1. For example, if the goal was not "Specific" then a score of 0 was given for this component. If the goal was "Realistic" then a score of 1 was given for that component. Information regarding the SMART goal components (Fernau, 2010):

Specific: The goal needs to be specific indicating the participant is clear on what they want to accomplish. For example, to state "I want to lose weight" is too broad and it would be difficult to evaluate the goal as it is not specific. For example, a specific goal would be to exercise using one's exercise bike for 30 minutes and calorie count between 1200 to 1400 calories each day.

Measurable: The goal needs to be something that can be measured so that the participant would know when they have accomplished the goal. For example, if one's goal is to exercise at a vigorous exercise intensity level then a measurable goal would be "I will exercise so that I will not be able to carry out a conversation for a 30 minute duration."

Attainable: The goal needs to be something that is attainable and something the participant can achieve. For example, an unattainable goal would be for a participant to state they will consume only 300 calories per day or want to exercise by sprinting for 3 hours a day. An attainable weight reduction goal would be to consume the recommended daily calorie amount (such as 1200 calories), and for a participant to gradually build up their exercise levels using a combination of power walking and then jogging each day for 40 minutes.

Realistic: The goal needs to be realistic and something that the participant can do. A realistic goal would be going to the gym three times a week for one hour, and

on the other days of the week setting the goal of going for a 30 minute walk around the local park.

Time Targeted: The goal needs to have a time frame. For example, at time-targeted goal would be to exercise 30 minutes per day or eat a calorie restricted diet for the program period of 12 weeks.

2. One point was allocated for goal relevance. That is, for physical activity a time, place or distance component was specified within the goal. For dietary intake a place, consideration or specification of calorie amount or energy intake allowance was specified within the goal. For example, a goal that included a time component of 30 minutes, or a distance component of 3 kilometres was allocated one point.

3. One point was allocated for goals that provided three or more pieces of detail. For example, for this factor a score of 0 was allocated to a goal stating "I'm going to walk the dog every morning," whereas a score of 1 was allocated for a goal stating "I'm going to walk the dog every morning to Beatty Park and back" as the person specified that they will be walking the dog and the walking location which accounts to two pieces of information.

Activities completed by intervention condition participants only.

Implementation intentions for physical activity and dietary intake

Implementation intentions were scored from 0 to 3 according to the below criteria:

0 = Implementation intention specifications were not provided. That is, no If/then plan formulation, or inclusion of the when, where, and/or how aspects.

1 = The plan included detail on one of the when, where, and/or how aspects.

2 = The plan included detail on two or three of the when, where, and/or how aspects.

Process mental imagery for physical activity and dietary intake

Process mental imagery was scored from 0 to 3 according to the below criteria:

0 = No mental imagery step details were provided.

1 = One to two pieces of detail on the mental imagery steps were stated.

2 = Three to four pieces of detail on the mental imagery steps were stated.

3 = Five or more pieces of detail on the mental imagery steps were stated.

Outcome mental imagery for weight-loss achievement

Outcome mental imagery was scored from 0 to 3 according to the below criteria:

0 = No mental imagery step details were provided.

1 = One to two pieces of detail on the mental imagery steps were stated.

2 = Three to four pieces of detail on the mental imagery steps were stated.

3 = Five or more pieces of detail on the mental imagery steps were stated.

Note. Participants in the psycho-education weight-loss condition were provided with a score of zero for each of the intervention condition activities as the participant was not required to complete the activity.

Appendix O: Conceptualisation of Outcome Categories

Biomedical variables were split into three categories.

1. Body composition measurements include the three variables of body weight, body fat percentage, and waist-hip ratio which were grouped together as they are measurements of body change.
2. Blood pressure measurements include the two variables of systolic blood pressure and diastolic blood pressure.
3. Blood lipoprotein were grouped together with six variables which include low-density lipoprotein (LDL), high-density lipoprotein (HDL), and total cholesterol (TC), triglycerides, blood glucose and insulin levels.

Psychological variables were split into four categories.

1. Psychological wellbeing measurements include the four variables of the impact of weight on quality of life, and symptoms of anxiety, depression, and stress.
2. Physical activity HAPA variables include the six HAPA variables related to physical activity which include action self-efficacy, maintenance self-efficacy, outcome expectancies, intention, action planning and motivation.
3. Dietary intake HAPA variables include the six HAPA variables related to dietary intake which include action self-efficacy, maintenance self-efficacy, outcome expectancies, intention, action planning and motivation.
4. Risk perception was one variable that was analysed alone as the risk perception items was a HAPA variable that relates to both physical activity and dietary intake.

Behavioural variables were split into three categories.

1. Nutrition and eating behaviour category includes four variables from the Three Factor Eating Questionnaire and Bailey Dietary Screening Questionnaire. That is, nutritional risk, uncontrolled eating, cognitive

restraint, and emotional eating which pertained to nutrition and eating behaviour.

2. Energy intake and expenditure category includes four variables that examined energy intake and expenditure, and some related variables. That is, dietary intake energy consumption and the related self-report of the dietary intake accuracy percentage, as well as physical activity energy expenditure and the related self-report of the physical activity input accuracy percentage. These variables all relate to the data from the three day drink, food, and exercise diary regarding energy consumption and expenditure, as well as how accurate the individual rated their diary input record.
3. Program compliance includes two variables that examine physical activity program compliance, and dietary intake program compliance. These two measures were grouped together as the variables relate to the individuals self-reported compliance to the behaviour changes of physical activity and dietary intake. Program compliance could not be measured at baseline as the participant had not yet engaged in the intervention program. These variables were only examined at two time points (week 6 and 12) hence a 3 (Conditions) x 2 (Time by measurement) MANOVA was conducted for this category.

Appendix P: Preliminary Analyses

Table P1

Baseline participant demographic variables among the three conditions

Variable	Statistic
Age	$F(2,71) = .56$, $p = .573$
Body weight (kilograms)	$F(2,71) = .82$, $p = .444$
Body mass index	$F(2,70) = .840$, $p = .436$
Mental imagery ability	$F(2,71) = 1.95$, $p = .150$
Male to female ratio	$\chi^2(2, N = 74) = 2.13$, $p = .345$

Table P2

Interrater reliability analysis for coding of intervention activity responses

Variable scores	Agreement measure (Kappa)	Asymptotic standard error	Approx. T	Approx. significance
PA goals	.926	.023	19.731	.000
DI goals	.837	.035	17.748	.000
PA implementation intention	1	.000	15.000	.000
DI implementation intention	1	.000	15.000	.000
PA process mental imagery	.991	.009	15.610	.000
DI process mental imagery	1	.000	17.223	.000
Outcome mental imagery	.946	.037	9.034	.000

Note. PA and DI are abbreviated for physical activity and dietary intake, respectively. The number of valid cases equated to 225 as participants completed three goals, implementation intention and process mental imagery step activities for both physical activity and dietary intake. The number of valid cases was 75 for the outcome mental imagery step activity as participants only completed this activity once.

Table P3

Goal setting among the three conditions

Variable scores	F statistic	Mean (standard deviation)			
		Condition 1	Condition 2	Condition 3	All
PA goal	$F(2, 70) = .17, p = .847$	18.60	19.04	18.60	18.75
		(2.53)	(1.87)	(4.28)	(3.02)
DI goal	$F(2, 69) = 1.15, p = .322$	18.73	20.08	19.10	19.31
		(3.44)	(1.04)	(4.20)	(3.20)

Note. PA and DI are abbreviated for physical activity and dietary intake, respectively. Condition 1 is the psycho-education weight-loss condition. Condition 2 is the psycho-education plus implementation intention and mental imagery condition. Condition 3 is the psycho-education plus implementation intentions and mental imagery with text messages conditions.

Table P4

Intervention activities among the intervention conditions

Variable scores	F statistic	Mean (standard deviation)		
		Condition 2	Condition 3	All
PA implementation intention	$F(1, 47) = .96, p = .332$	5.76	6.00	5.88
		(1.20)	(.00)	(.86)
DI implementation intention	$F(1, 47) = .96, p = .332$	5.76	6.00	5.88
		(1.20)	(.00)	(.86)
PA process mental imagery	$F(1,47) = .19, p = .666$	8.62	8.80	8.70
		(1.80)	(.72)	(1.37)
DI process mental imagery	$F(1, 47) = 1.17, p = .285$	8.36	8.80	8.57
		(1.91)	(.41)	(1.40)
Outcome mental imagery	$F(1, 47) = .06, p = .813$	2.84	2.88	2.86
		(.62)	(.37)	(.51)

Note. PA and DI are abbreviated for physical activity and dietary intake, respectively. Condition 1 is the psycho-education weight-loss condition. Condition 2 is the psycho-education plus implementation intention and mental imagery condition. Condition 3 is the psycho-education plus implementation intentions and mental imagery with text messages conditions.

Appendix Q: Assumption Testing Information

Table Q1

Multi-sample sphericity, skewness and kurtosis

Outcome type	Multi-sample Sphericity Assumption			Multivariate normality	
	MANOVA variables	F value	Box's M	Chi Square	*p*
Biomedical	Body composition	$F(90, 13385.60) = 1.13$, $p = .190$	124.838	156.903	0.000
	Blood pressure	$F(42, 14921.21) = 1.08$, $p = .335$	51.650	11.794	0.003
	Blood lipoproteins	$F(342, 11691.12) = 1.13$, $p = .047$*	642.747	736.007	0.000
Psychological	Psychological wellbeing	$F(156, 13393.12) = 1.42$, $p < .001$*	293.441	411.535	0.000
	Physical activity HAPA	$F(342, 13131.21) = 1.17$, $p = .019$*	636.426	151.754	0.000
	Dietary intake HAPA	$F(342, 13131.21) = 1.32$, $p < .001$*	716.677	116.919	0.000
Behavioural	Nutrition and eating behaviour	$F(156, 13393.12) = 1.23$, $p = .028$*	254.146	35.609	0.000
	Energy intake and expenditure	$F(156, 9479.29) = 3.25$, $p < .001$*	716.554	773.011	0.000
	Program compliance	$F(20, 14648.87) = 1.75$, $p = .020$*	38.475	9.190	0.010

Note. **p* value significant at the .05 level indicating that the assumption was violated. The psychological variable of risk perception was not included in this table as univariate normality was examined.

Table Q2

Individual sphericity

Outcome type	Variable category	Variable	Mauchly's W	Chi Square Value	*p*
Biomedical variables	Body composition	Body weight	.273	89.61	.000*
		Body fat percentage	.516	45.72	.000*
		Waist-hip ratio	.749	19.92	.000*
	Blood pressure	Systolic blood pressure	.927	5.30	.071
		Diastolic blood pressure	.972	2.01	.366
	Blood lipoproteins	Low-density lipoprotein	.907	6.43	.040*
		High-density lipoprotein	.943	3.88	.143
		Total cholesterol	.946	3.64	.162
		Triglycerides	.796	15.10	.001*
		Glucose	.841	11.46	.003*
		Insulin	.826	12.60	.002*
Psychological	Psychological wellbeing	Impact weight on quality of life	.731	21.93	.000*
		Depression symptoms	.589	37.07	.000*
		Anxiety symptoms	.624	33.06	.000*
		Stress symptoms	.749	20.28	.000*
		Action self-efficacy	.874	9.39	.009*

	Physical activity	Outcome expectancy	.964	2.59	.273
	HAPA	Maintenance self-efficacy	.837	12.46	.002*
		Intention	.910	6.64	.036*
		Planning	.757	19.53	.000*
		Motivation	.884	8.64	.013*
	Dietary intake HAPA	Action self-efficacy	.887	8.43	.015*
		Outcome expectancy	.872	9.63	.008*
		Maintenance self-efficacy	.702	24.78	.000*
		Intention	.739	21.22	.000*
		Planning	.851	11.30	.004*
		Motivation	.775	17.89	.000*
	Risk perception	Risk perception	.870	9.74	.008*
Behavioural	Nutrition and eating	Uncontrolled eating	.844	11.91	.003*
	behaviour	Cognitive restraint	.986	.98	.613
		Emotional eating	.955	3.25	.197
		Nutritional risk	.673	27.77	.000*
	Energy intake and	Dietary intake diary accuracy	.995	.30	.860
	expenditure	Physical activity diary accuracy	.639	24.44	.000*
		Energy with dietary fibre	.808	12.59	.002*
		Physical activity expenditure	.140	116.04	.000*

Note. **p* value significant at.05 level indicated assumption violation. The Mauchly's of Sphericity could not be conducted for program compliance.

Table Q3

Test of equality of error variance

Out-come	Variable category	Variable	Baseline	Week 6	Week 12
Biom-edical	Body composition	Body weight	$F(2,70)=2.12$, $p=.127$	$F(2,70)=1.95$, $p=.150$	$F(2,70)=1.41$, $p=.251$
		Body fat percentage	$F(2,70)=.15$, $p=.859$	$F(2,70)=.15$, $p=.864$	$F(2,70)=.43$, $p=.652$
		Waist-hip ratio	$F(2,70)=8.43$, $p=.001$*	$F(2,70)=8.26$, $p=.001$*	$F(2,70)=5.50$, $p=.006$*
	Blood pressure	Systolic blood pressure	$F(2,71)=.84$, $p=.436$	$F(2,71)=.91$, $p=.409$	$F(2,71)=1.46$, $p=.239$
		Diastolic blood pressure	$F(2,71)=.69$, $p=.503$	$F(2,71)=.35$, $p=.710$	$F(2,71)=.46$, $p=.631$
	Blood lipoproteins	Low-density lipoprotein	$F(2,67)=1.15$, $p=.324$	$F(2,67)=.23$, $p=.798$	$F(2,67)=.05$, $p=.953$
		High-density lipoprotein	$F(2,67)=1.24$, $p=.296$	$F(2,67)=1.10$, $p=.338$	$F(2,67)=.62$, $p=.541$
		Total cholesterol	$F(2,67)=1.34$, $p=.269$	$F(2,67)=.16$, $p=.857$	$F(2,67)=.12$, $p=.892$
		Triglyceride	$F(2,67)=1.32$, $p=.275$	$F(2,67)=1.92$, $p=.155$	$F(2,67)=2.92$, $p=.061$
		Glucose	$F(2,67)=1.94$, $p=.152$	$F(2,67)=1.02$, $p=.365$	$F(2,67)=.81$, $p=.451$
		Insulin	$F(2,67)=1.76$, $p=.180$	$F(2,67)=.15$, $p=.864$	$F(2,67)=2.05$, $p=.136$
Psycho-logical	Psycho-logical wellbeing	Impact weight on quality of life	$F(2,71)=.31$, $p=.734$	$F(2,71)=.64$, $p=.528$	$F(2,71)=.50$, $p=.607$
		Depression symptoms	$F(2,71)=.40$, $p=.669$	$F(2,71)=1.48$, $p=.234$	$F(2,71)=.58$, $p=.563$
		Anxiety symptoms	$F(2,71)=4.80$, $p=.011$*	$F(2,71)=.58$, $p=.561$	$F(2,71)=.41$, $p=.664$
		Stress symptoms	$F(2,71)=4.29$, $p=.017$*	$F(2,71)=.21$, $p=.808$	$F(2,71)=.34$, $p=.712$

	Physical activity HAPA	Action self-efficacy	$F(2,71)=.48$,$p=.623$	$F(2,71)=.05$, $p=.952$	$F(2,71)=.55$, $p=.578$
		Outcome expectancy	$F(2,71)=2.89$, $p=.062$	$F(2,71)=1.92$, $p=.154$	$F(2,71)=3.89$, $p=.025$*
		Maintenance self-efficacy	$F(2,71)=.33$, $p=.721$	$F(2,71)=.06$, $p=.945$	$F(2,71)=2.17$, $p=.122$
		Intention	$F(2,71)=.25$, $p=.778$	$F(2,71)=.47$, $p=.630$	$F(2,71)=1.11$, $p=.334$
		Action planning	$F(2,71)=.33$, $p=.718$	$F(2,71)=.83$, $p=.440$	$F(2,71)=2.01$, $p=.142$
		Motivation	$F(2,71)=.37$, $p=.692$	$F(2,71)=.51$, $p=.602$	$F(2,71)=1.46$, $p=.240$
	Dietary intake HAPA	Action self-efficacy	$F(2,71)=.94$, $p=.396$	$F(2,71)=1.28$, $p=.285$	$F(2,71)=3.07$, $p=.053$
		Outcome expectancy	$F(2,71)=1.36$, $p=.263$	$F(2,71)=2.64$, $p=.079$	$F(2,71)=1.14$, $p=.326$
		Maintenance self-efficacy	$F(2,71)=1.75$, $p=.182$	$F(2,71)=1.06$, $p=.353$	$F(2,71)=2.48$, $p=.091$
		Intention	$F(2,71)=.28$, $p=.756$	$F(2,71)=.59$, $p=.558$	$F(2,71)=1.63$, $p=.203$
		Action planning	$F(2,71)=.55$, $p=.582$	$F(2,71)=.20$, $p=.820$	$F(2,71)=.18$, $p=.837$
		Motivation	$F(2,71)=1.10$, $p=.339$	$F(2,71)=.46$, $p=.636$	$F(2,71)=1.06$, $p=.353$
	Risk	Risk perception	$F(2,71)=.91$, $p=.408$	$F(2,71)=1.91$, $p=.156$	$F(2,71)=5.02$, $p=.009$*
Behav-ioural	Nutrition and eating behaviour	Uncontrolled eating	$F(2,71)=3.89$, $p=.025$*	$F(2,71)=5.81$, $p=.005$*	$F(2,71)=2.97$, $p=.058$
		Cognitive restraint	$F(2,71)=.08$, $p=.927$	$F(2,71)=2.88$, $p=.063$	$F(2,71)=.58$, $p=.561$
		Emotional eating	$F(2,71)=.34$, $p=.714$	$F(2,71)=1.15$, $p=.322$	$F(2,71)=.50$, $p=.608$
		Nutritional risk	$F(2,71)=1.84$, $p=.166$	$F(2,71)=1.36$, $p=.263$	$F(2,71)=2.88$, $p=.062$
	Energy intake and expenditure	Physical activity expenditure	$F(2,60)=.92$, $p=.403$	$F(2,60)=2.39$, $p=.100$	$F(2,60)=.97$, $p=.385$
		Energy with dietary fibre	$F(2,60)=4.04$, $p=.023$*	$F(2,60)=9.08$, $p<.001$*	$F(2,60)=2.71$, $p=.074$
		Physical activity diary accuracy	$F(2,60)=1.52$, $p=.228$	$F(2,60)=.60$, $p=.553$	$F(2,60)=5.27$, $p=.008$*

	Dietary intake diary accuracy	$F(2,60)=.08$, $p=.924$	$F(2,60)=.20$, $p=.820$	$F(2,60)=1.26$, $p=.292$
Program compliance	Physical activity compliance	-	$F(2,64)=.22$, $p=.803$	$F(2,64)=.09$, $p=.914$
	Dietary intake compliance	-	$F(2,64)=1.81$, $p=.172$	$F(2,64)=.18$, $p=.838$

*p value significant at the .05 level indicates that the assumption was violated.

Appendix R: Baseline Variable Analyses

Table R1

Biomedical variables at baseline

Variable category	Variable	F Value
Body composition	Body weight	$F(2, 71) = .82$, $p = .444$
	Body fat percentage	$F(2, 70) = .93$, $p = .400$
	Waist-hip ratio	$F(2, 71) = 1.18$, $p = .314$
Blood pressure	Systolic blood pressure	$F(2, 71) = .40$, $p = .671$
	Diastolic blood pressure	$F(2, 71) = .83$, $p = .442$
Blood lipoproteins	Low-density lipoprotein	$F(2, 69) = .30$, $p = .742$
	High-density lipoprotein	$F(2, 70) = .33$, $p = .719$
	Total cholesterol	$F(2, 70) = .07$, $p = .930$
	Triglyceride	$F(2, 70) = .76$, $p = .473$
	Glucose	$F(2, 70) = .39$, $p = .676$
	Insulin	$F(2, 69) = .35$, $p = .703$

Table R2

Psychological variables at baseline

Variable category	Variable	F value
Psychological	Impact of weight on quality of life	$F(2, 71) = .20$, $p = .823$
wellbeing	Depression symptoms	$F(2, 71) = .88$, $p = .418$
	Anxiety symptoms	$F(2, 71) = 1.60$, $p = .210$
	Stress symptoms	$F(2, 71) = 2.31$, $p = .106$
Physical activity	Action self-efficacy	$F(2, 71) = .01$, $p = .994$
HAPA	Outcome expectancy	$F(2, 71) = .88$, $p = .421$
	Maintenance self-efficacy	$F(2, 71) = .14$, $p = .868$
	Intention	$F(2, 71) = .31$, $p = .736$
	Action planning	$F(2, 71) = 1.99$, $p = .144$
	Motivation	$F(2, 71) = .76$, $p = .471$
Dietary intake	Action self-efficacy	$F(2, 71) = .08$, $p = .927$
HAPA	Outcome expectancy	$F(2, 71) = 1.11$, $p = .335$
	Maintenance self-efficacy	$F(2, 71) = 1.17$, $p = .315$
	Intention	$F(2, 71) = .47$, $p = .628$
	Action planning	$F(2, 71) = 3.35$, $p = .041$*
	Motivation	$F(2, 71) = .14$, $p = .867$
Risk perception	Risk perception	$F(2, 71) = .80$, $p = .455$

Note. p * significant at the .05 level indicating the three conditions differed at baseline on the variable.

Table R3

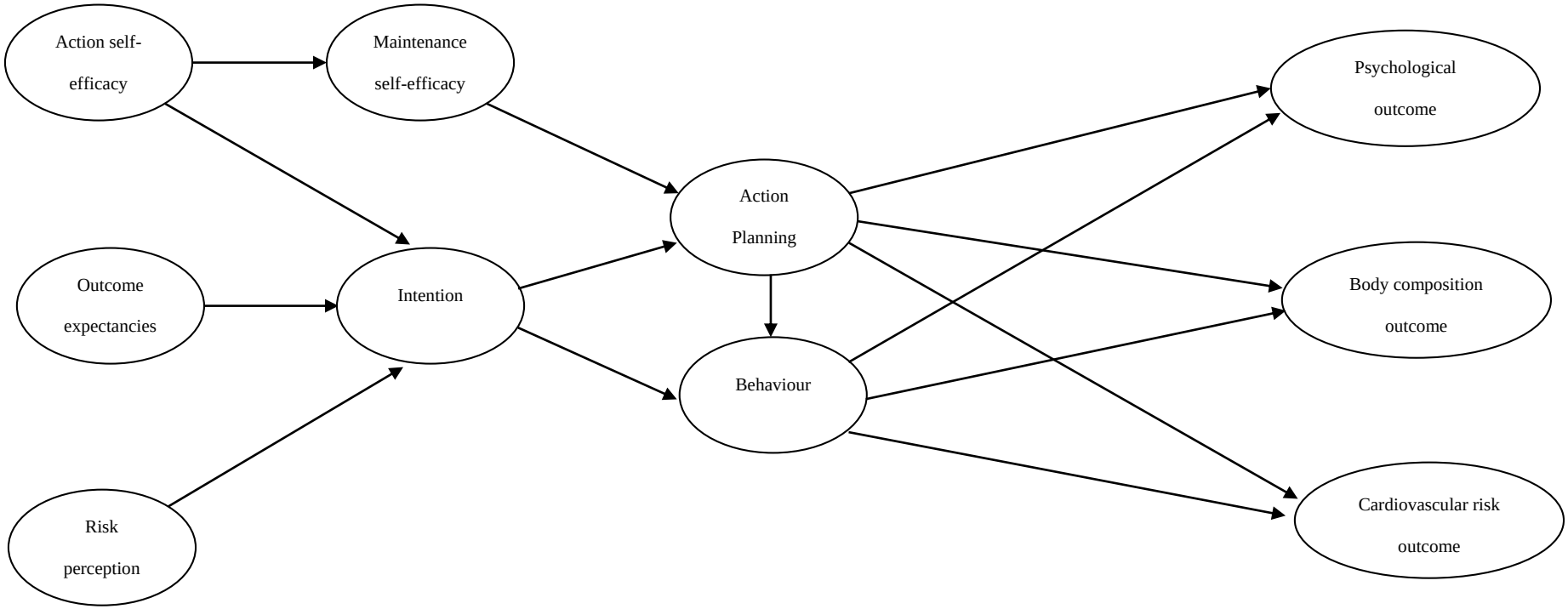
Behavioural variables at baseline

Variable category	Variable	F value
Nutrition and eating behaviour	Nutritional risk	$F(2, 71) = .10$, $p = .910$
	Uncontrolled eating	$F(2, 71) = 2.01$, $p = .142$
	Cognitive restraint	$F(2, 71) = 1.49$, $p = .233$
	Emotional eating	$F(2, 71) = 2.45$, $p = .093$
Energy intake and expenditure	Physical activity expenditure	$F(2, 70) = .33$, $p = .721$
	Dietary energy intake	$F(2, 70) = 1.03$, $p = .363$
	Physical activity accuracy	$F(2, 70) = .26$, $p = .773$
	Dietary intake accuracy	$F(2, 70) = .61$, $p = .546$
Program compliance	Physical activity compliance	$F(2, 70) = .56$, $p = .572$
	Dietary intake compliance	$F(2, 70) = .07$, $p = .932$

Note. ANOVA was conducted for the program compliance variables at the Week 6 time point (no baseline data).

Appendix S: Physical Activity Hypothesised Model

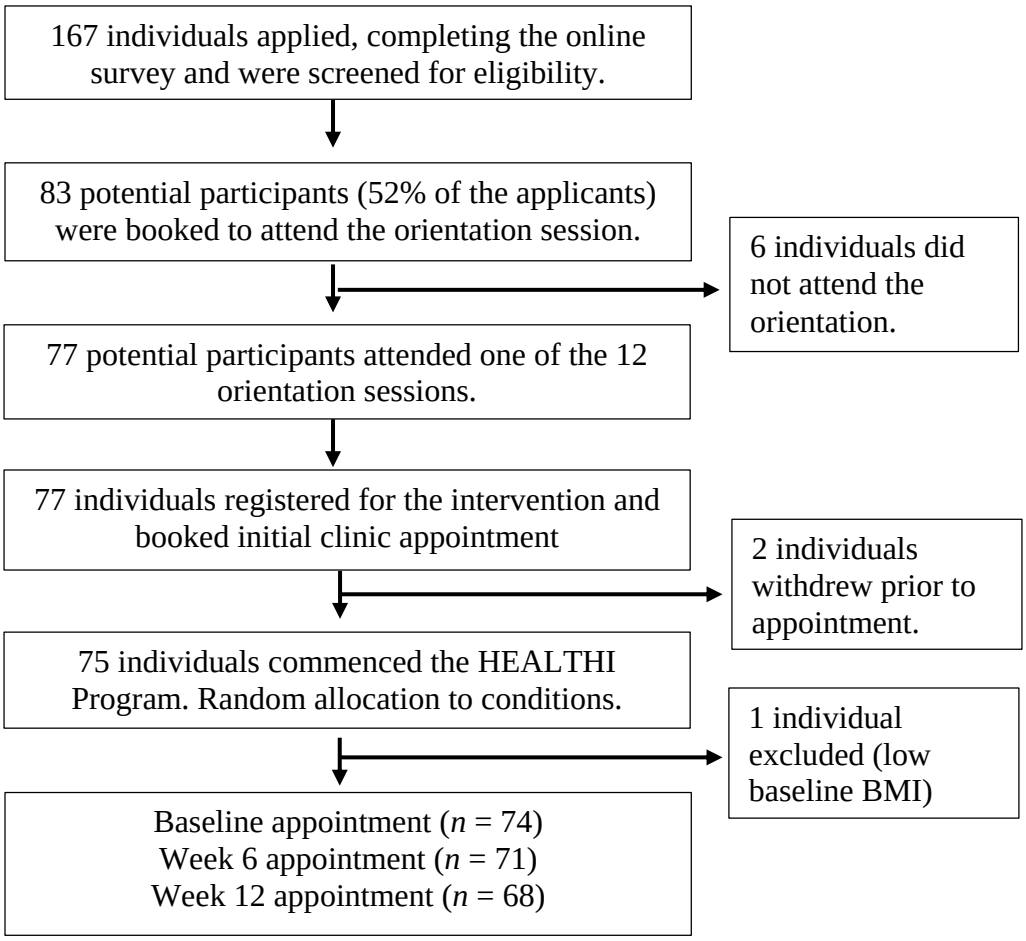
Figure S1. Summary of proposed model based on the Health Action Process Approach. All variables in the proposed model reflect changes in the variable across the intervention computed by regressing the follow-up measure of each variable (week 12) on the previous measures (baseline and week 6 measures).



Appendix T: Consolidated Standards of Reporting Trials

A CONSORT (Consolidated Standards of Reporting Trials) diagram of participant progress through the recruitment phases of the trial is available in the below figure. Potential participants who met the study inclusion criteria were invited to an orientation session. A total of 12 orientation sessions took place within a four month period. From the 77 participants who attended the orientation session, all voluntarily made the decision to enrol in the HEALTHI program, however thereafter two participants withdrew prior to the initial clinic appointment. From the 75 participants who commenced the HEALTHI program, one participant's data was excluded from all analyses due to a low baseline body mass index (BMI) of 24 thus not meeting the study inclusion criteria. This left a total of 74 participant data sets, with 67 of these participants having remained at the week 12 time point. Participant withdrawal reasons included: pregnancy (one participant), dislike of the calorie counting method, pathology appointment, and three day diary (one participant), personal stress unrelated to the program (one participant), unable to return to Australia (one participant), and non-attendance to the future appointment without explanation or contact (three participants).

Figure T1. CONSORT diagram of participant progress through the phases of the trial.



Appendix U: Physical Activity HAPA Measures

Table U1

Details of measures used to tap variables of proposed model based on the HAPA

Scale	Items	Scale anchors
Risk	I *think it is likely* that I will develop health problems related to obesity at *some point in my life*	1 = Strongly disagree, 5 = Strongly agree.
Perception	Personally, I *feel vulnerable* to developing health problems related to obesity at *some point in my life*	
	Compared to the average person, I feel that my chance of developing health problems related to obesity is:	1 = Much lower, 5 = Much higher.
	How likely do you think it is that you will get health problems related to obesity at *some point in the future*?	1 = Not likely, 5 = Extremely likely
Outcome expectancy	I think that engaging in daily *physical activity* with a minimum of 30 minutes of planned exercise is a very important way to help me to lose weight.	1 = Strongly disagree, 5 = Strongly agree.
	I believe that engaging in daily *physical activity* with a minimum of 30 minutes of planned exercise will help me to lose weight.	
	How effective do you feel that engaging in daily *physical activity* with a minimum of 30 minutes of planned exercise would be to help you to lose weight?	1= Not at all effective, 5 = Extremely effective
Action self-efficacy	If it were entirely up to you, how confident are you that you would be able to participate in daily *physical activity* with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks?	1 = Not confident, 5 = Completely confident.

	How confident are you that you can complete daily *physical activity* with a minimum of 30 minutes of planned exercise no matter what, on each individual occasion over the next 6 weeks?	
	How confident are you that you can arrange your schedule to include daily *physical activity* with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks?	
	To what extent do you see yourself as being capable of participating in daily *physical activity* with a minimum of 30 minutes of planned exercise, on each individual occasion over the next 6 weeks?	1 = Not likely, 5 = Extremely likely.
	I believe I have the ability to participate in daily *physical activity* with a minimum of 30 minutes of planned exercise, on each individual occasion over the next 6 weeks?	1 = Strongly disagree, 5 = Strongly agree.
Maintenance self-efficacy	Stem: How *confident* are you that you will do daily *physical activity* with a minimum of 30 minutes of planned exercise during your leisure time on each individual occasion over the next 6 weeks even if… …you get busy and have limited time? …the weather is very bad? …you are feeling tired? …you are feeling stressed? …there are competing interests like …your favourite TV show? …you have no one to do physical activity with? …you are not enjoying your physical activity? …you do not receive support from your family or friends? …you have other things you like to do in your spare time to do?	1 = Not confident, 5 = Completely confident
Intention	I intend to participate in daily *physical activity* with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks.	1 = Strongly disagree, 5 = Strongly agree.
	I will try to engage in daily *physical activity* with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks.	

Action Planning	I have made a detailed plan about when, where, and how I will do daily *physical activity* with a minimum of 30 minutes of planned exercise on each individual occasion over the next 6 weeks.	1 = Strongly disagree, 5 = Strongly agree.

Appendix V: Reliability, Indices, Means and Intercorrelations (Physical Activity model)

Table V1

Reliability Indices, Means with Standard Deviations, and Intercorrelations for Model Variables at Baseline

Variable	Cronbach alpha (number of items)	Mean (standard deviation)	Variable correlations												
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Risk perception	.921 (*n* = 4)	3.58 (.99)	-													
2. Outcome expectancies	.542 (*n* = 3)	4.57 (.43)	.021	-												
3. Action self-efficacy	.855 (*n* = 5)	3.79 (.76)	.131	.274*	-											
4. Maintenance self-efficacy	.916 (*n* = 9)	3.73 (.82)	-.041	.179	.624** *	-										
5. Intention	.551 (*n* = 2)	4.66 (.54)	.115	.357**	.505***	.544***	-									
6. Action planning	–	3.12 (1.37)	.137	.237*	.564***	.343**	.437***	-								

7. Quality life (IWQOL)	.937 (*n* = 31)	2.11 (.61)	.574***	-.128	.021	-.094	.113	.095	-						
8. Depression (DASS)	.863 (*n* = 7)	.52 (.55)	.157	-.165	-.149	-.196	.007	-.164	.571***	-					
9. Anxiety (DASS)	.764 (*n* = 7)	.31 (.41)	.101	.072	-.102	-.195	-.083	-.226	.407***	.561***	-				
10. Stress (DASS)	.862 (*n* = 7)	.70 (.54)	.060	-.228	-.103	-.122	-.077	-.154	.396***	.735***	.622***	-			
11. Total cholesterol	–	5.15 (.85)	-.010	-.170	.039	.051	-.174	.151	-.046	-.083	-.140	.003	-		
12. Low-density lipoprotein	–	3.06 (.77)	.004	-.107	.123	.102	-.144	.201	-.034	-.088	-.054	.028	.906***	-	
13. Body weight	–	88.17 (14.24)	.277*	.021	.005	.067	-.096	-.123	.109	-.092	-.142	-.103	-.003	.159	-
14. Body fat mass	–	37688.00 (8616.04)	.488***	.093	-.043	-.023	-.067	-.004	.259*	-.086	-.080	-.111	.025	.139	.764***	-

Note. p * < .05, ** < .01, *** <.001.

Table V2

Reliability Indices, Means with Standard Deviations, and Intercorrelations for Model Variables at Week 6

Variable	Cronbach alpha (number of items)	Mean (standard deviation)	Variable correlations													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Risk perception	.935 (*n* = 4)	3.24 (1.10)	-													
2. Outcome expectancies	.801 (*n* = 3)	4.60 (.55)	.019	-												
3. Action self-efficacy	.910 (*n* = 5)	3.71 (.93)	-.149	.433***	-											
4. Maintenance self-efficacy	.950 (n = 9)	3.58 (1.01)	-.185	.341**	.851***	-										
5. Intention	.913 (*n* = 2)	4.38 (.72)	-.069	.502***	.761***	.608***	-									
6. Action planning	–	3.79 (1.14)	-.056	.409***	.598***	.538***	.512***	-								
7. Physical activity behaviour	.579 (*n* = 2)	3.78 (.91)	-.041	..070	.443***	.438***	.313**	.259*	-							
8. Quality life (IWQOL)	.955 (*n* = 31)	1.89 (.64)	.538***	-.056	-.233	-.197	-.251*	-.215	-.056	-						

9. Depression (DASS)	.865 (n = 7)	.36 (.47)	.253*	-.325**	-.306*	-.313**	-.190	-.459***	.002	.505***	-					
10. Anxiety (DASS)	.724 (n = 7)	.22 (.33)	.245*	-.236*	-.204	-.189	-.310**	-.279*	.088	.564***	.636***	-				
11. Stress (DASS)	.885 (n = 7)	.61 (.53)	.002	-.292*	-.173	-.127	-.201	-.260	.102	.400**	.693***	.647***	-			
12. Total cholesterol	–	4.86 (.98)	-.028	.018	-.053	-.108	.003	.073	-.301**	-.048	.072	-.099	-.011	-		
13. Low-density lipoprotein	–	3.06 (.77)	-.073	.153	.140	.103	.122	.162	-.138	-.096	-.140	-.195	-.135	.672***	-	
14. Body weight	–	85.44 (13.00)	.251*	-.355**	-.203	-.160	-.214	-.139	-.095	.240*	.087	.025	-.051	-.065	.127	-

Note. p * < .05, ** < .01, *** <.001.

Table V3

Reliability Indices, Means with Standard Deviations, and Intercorrelations for Model Variables at Week 12

Variable	Cronbach Alpha (number items)	Mean (standard deviation)	Variable correlations													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Risk perception	.961 (*n* = 4)	3.12 (1.20)	-														
2. Outcome expectancies	.807 (*n* = 3)	4.57 (.54)	.011	-													
3. Action self-efficacy	.934 (*n* = 5)	3.71 (.99)	-.286*	.224	-												
4. Maintenance self-efficacy	.969 (*n* = 9)	3.46 (1.16)	-.316**	.139	.903***	-											
5. Intention	.945 (*n* = 2)	4.21 (.92)	-.392**	.093	.803***	.762***	-										
6. Action planning	–	3.58 (1.25)	-.124	.190	.619***	.637***	.706***	-									
7. Physical activity behaviour	.851 (*n* = 2)	3.64 (1.04)	-.159	.098	.648***	.697***	.654***	.527***	-								
8. Quality life (IWQOL)	.968 (*n* = 31)	1.71 (.66)	.570***	-.077	-.273*	-.342**	-.411**	-.329**	-.338**	-							

9. Depression (DASS)	.858 (*n* = 7)	.30 (.42)	.378 **	-.113	-.243 *	-.233	-.295 *	-.279 *	-.354 **	.610 ***	-						
10. Anxiety (DASS)	.878 (*n* = 7)	.24 (.43)	.434 ***	-.107	-.048	-.120	-.133	-.063	-.294 *	.639 ***	.792 ***	-					
11. Stress (DASS)	.861 (*n* = 7)	.61 (.53)	.184	-.196	-.156	-.178	-.093	-.064	-.120	.503 ***	.660 ***	.649 ***	-				
12. Total cholesterol	–	4.92 (.90)	-.088	-.009	-.219	-.251 *	-.141	-.173	-.203	.011	-.076	-.165	-.073	-			
13. Low-density lipoprotein	–	2.92 (.75)	-.081	.053	-.178	-.239	-.108	-.136	-.200	-.002	-.123	-.171	-.178	.921 ***	-		
14. Body weight	–	83.82 (12.88)	.360 **	-.212	-.244 *	-.257 *	-.344 **	-.231	-.221	.282 *	.121	.182	-.088	.014	.106	-	
15. Body fat mass	–	34495.29 (8353.84)	.565 ***	.067	-.387 **	-.438 ***	-.532 ***	-.287 *	-.399 **	.461 ***	.180	.202	.118	.182	.231 *	.733 ***	-

Note. p * < .05, ** < .01, *** <.001.

Appendix W: Parameter Estimates Excluded from Figure 5.1 (Physical Activity model)

Table W1

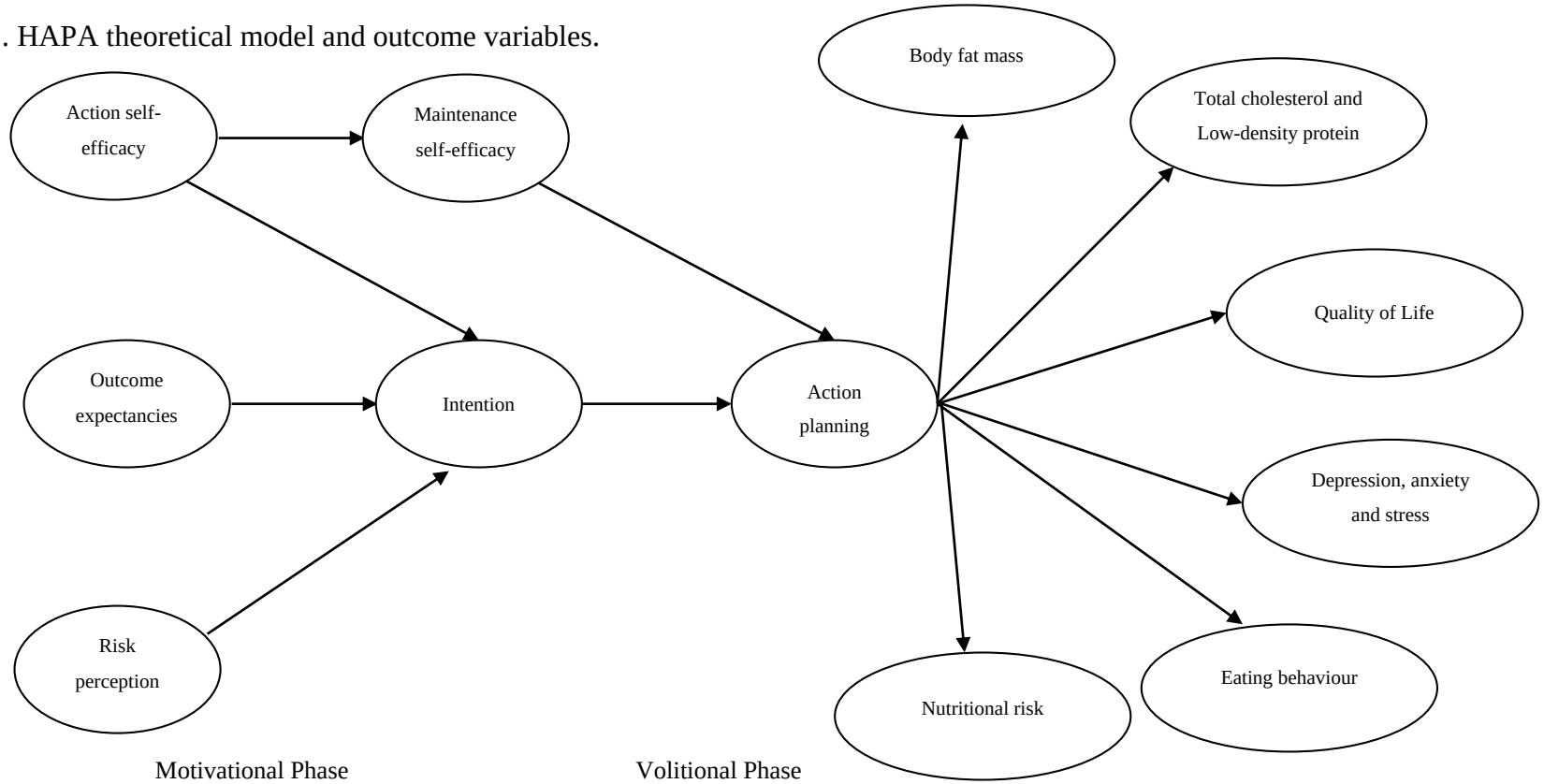
Parameter estimates for statistically non-significant effects R for variables included in the structural equation model

Hypothesis	Independent variable[a]	Dependent variable	Mediator/mediators	Parameter estimate and *p*-values
H_3	Risk perception	Intention	–	β = -.133, *p* = .118
H_{8c}	Behaviour	Cardiovascular risk outcome	–	β =-.111, *p* = .162
H_{10}	Action planning	Behaviour	–	β = .085, *p* = .229
H_{13}	Intention	Behaviour	Action planning	β = .036, *p* = .331
H_{15a}	Action planning	Psychological outcome	Behaviour	β = -.028, *p* = .368
H_{15b}	Action planning	Body composition outcome	Behaviour	β = -.021, *p* = .399
H_{15c}	Action planning	Cardiovascular risk outcome	Behaviour	β = -.009, *p* = .454

Note. [a]All variables in the proposed model reflect changes in the variable across the intervention computed by regressing the follow-up measure of each variable (week 12) on the previous measures (baseline and week 6 measures).

Appendix X: Dietary Intake HAPA Theoretical Model

Figure X1. HAPA theoretical model and outcome variables.



Note. Variable change was measured at week 12 from baseline, controlling for week 6, gender, age, and group condition. Body fat mass change was measured at week 12 from baseline, controlling for gender, age, and group condition.

Appendix Y: Dietary Intake HAPA Measures

Table Y1

Details of measures used to tap variables of proposed model based on the HAPA

Scale variables	Items	Scale anchors
Risk Perception	I *think it is likely* that I will develop health problems related to obesity at *some point in my life*	1 = Strongly disagree, 5 = Strongly agree
	Personally, I *feel vulnerable* to developing health problems related to obesity at *some point in my life*	
	Compared to the average person, I feel that my chance of developing health problems related to obesity is:	1 = Much lower, 5 = Much higher.
	How likely do you think it is that you will get health problems related to obesity at *some point in the future*?	1 = Not likely, 5 = Extremely likely
Outcome expectancy	I think that consuming *fewer calories* per day is a very important way to help me to lose weight.	1 = Strongly disagree, 5 = Strongly agree.
	I believe that consuming *fewer calories* per day will help me to lose weight.	
	How effective do you feel that consuming *fewer calories* per day would be to help you to lose weight?	1= Not at all effective, 5 = Extremely effective
Action self-efficacy	If it were entirely up to you, how confident are you that you would be able to follow a *diet* that requires you to consume fewer calories per day on each individual occasion over the next 6 weeks?	1 = Not confident, 5 = Completely confident.
	How confident are you that you can follow a *diet* that requires you to consume fewer calories per day no matter what on each individual occasion over the next 6 weeks?	

	How confident are you that you can arrange your schedule to include a *diet* that requires you to consume fewer calories per day into your lifestyle on each individual occasion over the next 6 weeks?	
	To what extent do you see yourself as being capable of following a *diet* that requires you to consume fewer calories per day on each individual occasion over the next 6 weeks?	1 = Not likely, 5 = Extremely likely
	I believe I have the ability to follow a *diet* that requires me to consume fewer calories per day on each individual occasion over the next 6 weeks.	1 = Strongly disagree, 5 = Strongly agree.
Maintenance self-efficacy	Stem: How *confident* are you that you will follow a *diet* that requires you to consume fewer calories per day on each individual occasion over the next 6 weeks *even if*… …you get busy and have limited time? …the weather is very bad? …you are feeling tired? …you are feeling stressed? …there are competing interests like …your favourite TV show? …you have no one to diet with you? …you are not enjoying your diet? …you do not receive support from your family or friends? …you have other things you like to do in your spare time to do?	1 = Not confident, 5 = Completely confident
Intention	I intend to follow a *diet* that requires me to consume fewer calories per day on each individual occasion over the next 6 weeks.	1 = Strongly disagree, 5 = Strongly agree.
	I will try to follow a *diet* that requires me to consume fewer calories per day on each individual occasion over the next 6 weeks.	
Planning	I have made a detailed plan about when, where, and how I will follow a *diet* that requires me to consume fewer calories per day on each individual occasion over the next 6 weeks.	1 = Strongly disagree, 5 = Strongly agree.

Appendix Z: Parameter Estimates Excluded from Figure 6.1 (Dietary Intake model)

Table Z1

Parameter estimates for statistically non-significant effects R for variables included in the structural equation model

H	Independent variable	Dependent variable	Mediator/mediators	Effect size
H_4	Maintenance self-efficacy	Action planning		β = .007, *p* = .476
H_5	Outcome expectancies	Intention		β = -.165, *p* = .070
H_6	Risk perception	Intention		β = -.156, *p* = .082
H_{10}	Outcome expectancies	Action planning	Intention	β = -104. *p* = .098
H_{11}	Risk perception	Action planning	Intention	β = -.098, *p* = .111
H_{13a}	Maintenance self-efficacy	Body fat mass	Action planning	β = -.002, *p* = .491
H_{13b}	Maintenance self-efficacy	Cholesterol and low-density protein	Action planning	β = -.002, *p* = .488
H_{13c}	Maintenance self-efficacy	Quality of life	Action planning	β = -.002, *p* = .489
H_{13d}	Maintenance self-efficacy	Depression, anxiety, stress	Action planning	β = .002, *p* = .491
H_{13e}	Maintenance self-efficacy	Eating behaviour	Action planning	β = -.002, *p* = .490
H_{13f}	Maintenance self-efficacy	Nutritional risk	Action planning	β = .002, *p* = .491
H_{14a}	Action self-efficacy	Body fat mass	Maintenance self-efficacy & Action planning	β = -.066, *p* = .159

H_{14b}	Action self-efficacy	Cholesterol and low-density protein	Maintenance self-efficacy & Action planning	β = -.084, *p* = .102
H_{14c}	Action self-efficacy	Quality of life	Maintenance self-efficacy & Action planning	β = -.077, *p* = .122
H_{14d}	Action self-efficacy	Depression, anxiety, stress	Maintenance self-efficacy & Action planning	β = .064, *p* = .167
H_{14e}	Action self-efficacy	Eating behaviour	Maintenance self-efficacy & Action planning	β = -.072, *p* = .137
H_{14f}	Action self-efficacy	Nutritional risk	Maintenance self-efficacy & Action planning	β = .061, *p* = .177
H_{15d}	Action self-efficacy	Depression, anxiety, stress	Intention & Action planning	β = .106, *p* = .053
H_{15f}	Action self-efficacy	Nutritional risk	Intention & Action planning	β = .102, *p* = .061
H_{16a}	Outcome expectancies	Body fat mass	Intention & Action planning	β = .028, *p* = .336
H_{16b}	Outcome expectancies	Cholesterol and low-density protein	Intention & Action planning	β = .036, *p* = .296
H_{16c}	Outcome expectancies	Quality of life	Intention & Action planning	β = .033, *p* = .311
H_{16d}	Outcome expectancies	Depression, anxiety, stress	Intention & Action planning	β = -.027, *p* = .341
H_{16e}	Outcome expectancies	Eating behaviour	Intention & Action planning	β = .031, *p* = .322
H_{16f}	Outcome expectancies	Nutritional risk	Intention & Action planning	β = -.026, *p* = .348
H_{17a}	Risk perception	Body fat mass	Intention & Action planning	β = .027, *p* = .344
H_{17b}	Risk perception	Cholesterol and low-density protein	Intention & Action planning	β = .034, *p* = .306

H_{17c}	Risk perception	Quality of life	Intention & Action planning	β = .031, *p* = .320
H_{17d}	Risk perception	Depression, anxiety, stress	Intention & Action planning	β = -.026, *p* = .349
H_{17e}	Risk perception	Eating behaviour	Intention & Action planning	β = .029, *p* = .331
H_{17f}	Risk perception	Nutritional risk	Intention & Action planning	β = -.025, *p* = .355
H_{19a}	Action self-efficacy	Body fat mass	[a] Maintenance self-efficacy & Action planning, Intention & Action planning	β = -.112, *p* = .114
H_{19b}	Action self-efficacy	Cholesterol and low-density protein	[a] Maintenance self-efficacy & Action planning, Intention & Action planning	β = -.141, *p* = .062
H_{19c}	Action self-efficacy	Quality of life	[a] Maintenance self-efficacy & Action planning, Intention & Action planning	β = -.130, *p* = .079
H_{19d}	Action self-efficacy	Depression, anxiety, stress	[a] Maintenance self-efficacy & Action planning, Intention & Action planning	β = .108, *p* = .122
H_{19e}	Action self-efficacy	Eating behaviour	[a] Maintenance self-efficacy & Action planning, Intention & Action planning	β = -.122, *p* = .093
H_{19f}	Action self-efficacy	Nutritional risk	[a] Maintenance self-efficacy & Action planning, Intention & Action planning	β = .103, *p* = .132

Note. ***** Effect comprised of indirect effects with two, three segment pathways of maintenance self-efficacy and action planning, and three segment pathway of intention and action planning.